MARINE ENGINEERING.

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LAKE MICHIGAN CAR-FERRY STEAMER PERE MARQUETTE OF THE F. & P. M. R. R.

Our front page shows the magnificent lake car-ferry steamer Pere Marquette approaching Ludington, Mich., the western terminus of the Flint and Pere Marquette Railroad. In our issue of May last we published an extensive description of the design and construction of this vessel, which is the largest seagoing car-ferry in any waters. At that time, however, the photograph which we are now able to present through the courtesy of the builders, F. W. Wheeler & Co., West Bay City, Mich., had not been taken. The general dimensions of the vessel are: Length, 350 ft.; breadth, 56 ft., and depth, from keel to upper deck, 36 ft. 3 in. When loaded with thirty freight cars she displaces 4,050 tons on 12 ft. 3 in. draught of water. In open water she easily reaches a speed of 16 miles, and she has a record of 10 miles an hour continuously through 14 in. of solid ice. The run between Ludington, Mich., and Manitowoc, Wis., is 56 miles and the trip is usually made in 3 1-2 hours. The Pere Marquette was built specially with a view to all-the-year-round service.

Vessels of this class have become very numerous on the lakes, especially on Lake Michigan, in the past few years. There are now fourteen large car-ferry steamers in operation with a total capacity of 287 cars, besides nineteen barge car floats towed by powerful tugs, which have track room for 145 cars, making a total for all boats of 432 cars. It will be remembered that when the Russian Government was contemplating the construction of ice crushing steamers for the trans-Siberian route, a board of experts was sent to this country to examine and report upon the lake vessels. As a result a ferry of the lake type was built for service on Lake Baikal.

LAKE MICHIGAN CAR-FERRY STEAMER PERE MARQUETTE APPROACHING LUDINGTON HARBOR.

QUADRUPLE-EXPANSION ENGINE AT FIVE HUNDRED POUNDS PRESSURE.*—II.

BY DR. R. H. THURSTON.

The investigation to be here described was made for the purpose of securing data which might afford some basis for inference of the probable gain to be actually secured by increase of steam-pressures to figures far above any at present in vogue, and to ascertain whether it may be fairly anticipated that, at such high pressures, we may secure as satisfactory approximation to the ideal case as with engines now in operation at standard steam-pressures.

The engine employed was designed, in consultation with the officers of Sibley College, by two graduates of the college engaged in advanced work, both of whom were good mechanics, as well as, as proved by their success in this instance, excellent designers and inventors—Messrs. Thos. Hall and Chas. H. Treat, members of the A. S. M. E., and now holding advanced degrees, from Cornell University, in engineering science. The research was mainly conducted by them, with such aid of officers and students as was available and applicable, and it was supplemented by independent work on the part of Messrs. Mitchel and Reeder and others. The design and construction and the experimental use of the engine occupied three years; the design and construction being entirely the work of Messrs. Hall and Treat. They introduced some new and valuable features, and their work admirably illustrates their mechanical skill. Continued use revealed opportunities to improve some minor points in construction of details; but, were the engine to be reproduced to-day, it may be doubted whether its builders would make any important changes in proportions or in the design of the engine or of its details.

The exterior of the engine, as finally constructed and operated, is seen in the engravings, Figs. 3 and 4; the former exhibiting the front, the latter the rear of the machine. Four cylinders were employed and the quadruple-expansion engine adopted as, with even the moderate ratio of three expansions in each cylinder, the total ratio, eighty-one, would suffice for, it was believed, practically any pressure to be employed in any experiments to be made. In fact, with a minimum terminal pressure of ten or fifteen pounds—which would not be likely to prove very far from figures of maximum economy with such an engine—the steam might be expanded from 1,000 pounds pressure with advantage. It would certainly give ample expansion for 500 pounds, absolute. The fact proved to be—whether due to leakage or other causes is not yet known—that the best work was done at 300 to 400 pounds. A system of reheaters in the boiler and flues permitted the re-evaporation between cylinders of any water of condensation; a reheater being set between each pair in series, or *en cascade*, as French engineers put it. Steam-jackets were not used. Provision was made for experimentally using non-conductors on heads and pistons, as proposed by many engineers, and as experimentally used on a small simple engine earlier. The cylinders are closely set and the cranks are at angles of 180 degrees, giving perfect balance. The engine has been driven at 500 revolutions per minute, loosely set on blocks, without shake or jar.

The valve-gearing exhibits the ingenuity of its designers, perhaps better than any other portion of the machine. As they stated:

"A suitable valve gear for an experimental engine is a difficult problem. It must give good steam distribution. It must be capable of adjustment for a wide range of cut-off, and compression, and release should also be under easy control. For this engine it must be capable of running at high speed.

"Plain slide valves are not adjustable. Separate steam and exhaust valves of this type would have added very greatly to the work of construction, and would not have fulfilled the requirement of ease in adjustment. Corliss gearing would not have withstood the high speed contemplated. A suitable gearing required to be positively connected and also required ample port area, and quick opening and closing of the valves, also ease in adjustment.[9]

"The gearing shown in the engraving was finally worked out. The steam valves admit steam through a slot in center. Steam is admitted by one edge of the slot and cut off by the other. Both events occur at each stroke of the valve, and the motion of the gearing need be only half as rapid as ordinarily, reducing the inertia effect to one-fourth. Spiral gears give this reduction of speed, and transmit the motion to the sliding-block movement on the front of the engine. This latter device operates to give the valves quick movement during admission, and reduces over-travel. It consists of a bell-crank carrying a block in the longer arm sliding in a slot in the wrist-plate. The other arm of the bell-crank lever is connected to the driving crank of the valve-motion driving shaft. Two of these motions are necessary, one controlling the steam valve at one end of any cylinder and the other the steam valve at the other end. The reason for two is, that one motion can give quick movement only once in a complete rotation; but one end of a cylinder must have steam 180 degrees after the other in a double-acting engine. By referring to the cut it will be seen that lost motion in the lower connections will be much reduced by the sliding-block device. When the block is near the end of the slot the wrist-plate will not move at all. When at the center of its travel the valves are wide open, and a little one way or the other makes no material difference.

* First chapter appeared in our issue of November, last.

[9] Power, 1895; *Trans.* A. S. M. E. 1896; No. DCCXVIII.

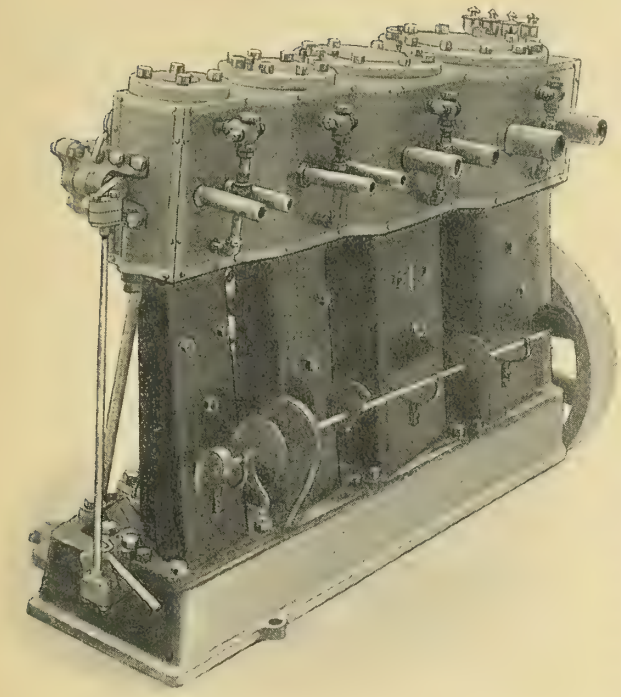


FIG. 4.—BACK VIEW OF EXPERIMENTAL ENGINE.

"When the block is moving at the end of the slot the fly-wheel may be turned thirteen out of thirty-two equal divisions of its circumference without producing any perceptible motion of the valve-arm, showing the extent to which over-travel of the valve is reduced. The valves are only one inch in diameter, yet some of the ports are more than three-eighths inch wide. As the valve passes over the port from one side to the other the port must always be completely opened during admission, no matter how early the cut-off. All steam-valve rods and rods transmitting motion to the sliding-block movement are made of bicycle tubing with ends brazed into them. The spiral gears are made of mild steel, to run in oil.

"The exhaust valves resemble the Corliss, and are driven by the crank at the end of the shaft. In case of accident, to stop the engine quickly, this crank may be loosened on the shaft, and so stop all the exhaust valves at once. This, in fact, is the usual method of stopping the engine, and proves both safe and handy. The steam valves lift, so that if an exhaust valve is left closed the steam in the cylinder is forced back into the previous receiver or into the boiler. If the valve is left open, on the other hand, steam may blow through into the next receiver. The receivers are provided with safety valves, so that the pressure in them can never become dangerous. By setting the engine at admission and changing this exhaust

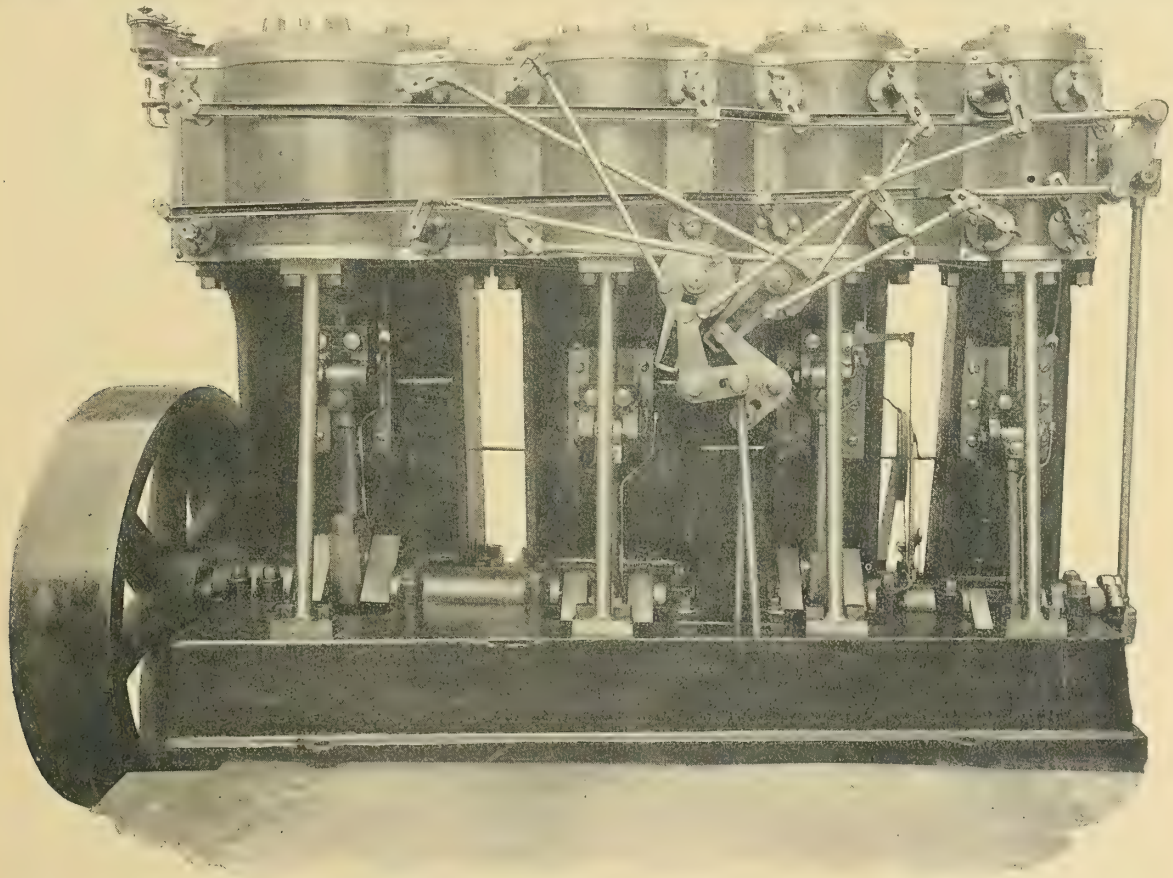


FIG. 3.—SIBLEY COLLEGE, FOUR-CYLINDER, QUADRUPLE-EXPANSION EXPERIMENTAL ENGINE.

crank, steam may be blown through the entire engine. This is convenient in warming it up.

"The stuffing-boxes are nearly long enough to prevent any of the rod exposed to steam reaching the outside air. They are packed with asbestos wicking and graphite. The deep stuffing-box is easy to keep tight.

"All parts are strong enough to carry full steam pressure in either of the first three cylinders and 150 pounds in the low pressure. This admits of any combination desired.

"As the number of cylinders and the rotative speed is increased, the work lost in friction becomes a greater and greater item. It is a large percentage of the total friction. To reduce it, the journals should be made as small as possible consistent with strength. This demands that the shaft be made of the strongest material obtainable. The extra first cost is very small compared to the saving it will make in a few years. The shaft in this engine was forged by the Bethlehem Iron Company, out of their steel. It was the only piece made outside the Sibley College shops."

The connections were so arranged that it was possible either to use the reheaters or to send the steam direct from cylinder to cylinder. The work was adjusted and measured by a friction-brake to which was ingeniously attached a fly-ball governor in such manner as to regulate the speed of the engine by tightening or slacking up the brake-band. An adjustable spring gave the required set load. An automatic recording apparatus was also mounted beside the brake, giving a continuous record of work performed and power exerted. (Fig.5.)

The boiler is an original construction, of water-tube type, designed for 1,000 pounds pressure and actually tested, when completed, at 1,350 pounds. It is shown in Fig. 6. It consists of an aggregation of coils of lap-welded, extra heavy, 1 1-4 in. steam pipe, about 100 ft. total length, set in five concentric coils. Steam- and mud- drums are attached, and a dry-pipe is introduced into the former. The drum is steel, lap-welded, 5-8 in. thick, and 12 in. dia. Its length is 6 1-2 ft. The heads are flat, held by a central stay-bolt reaching from the one to the other, and intended to act as a safety-valve, in case of necessity, stretching 1-2 in. under excessive pressure without risk, and to that extent allowing the heads to lift clear. Engine and boiler have been worked together without trouble at 620 pounds pressure.

In the work of investigation, special indicators were constructed to suit the extraordinary pressures employed, and every precaution taken to insure scientific accuracy of method and results.[10] The methods adopted were those which are accepted as standard in the practice of the Sibley College laboratories and by the profession. No special difficulty was met with in the conduct of the trials, apart from those coming of the peculiar conditions of the case especially such as, for example, were due to frequent breakage of water-gauge glasses and to trouble with injectors and pumps constructed for ordinary pressures. These were evaded, however, by the inventive talent of the experimentalists. Gauge-glasses were given

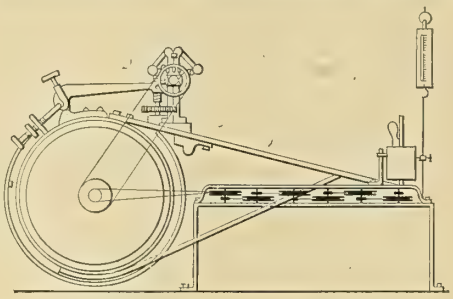


FIG. 5—AUTOMATIC BRAKE.

up and a float of aluminum, sustained by a fine wire rising through a fitted long drilled hole in the water-column, without packing of any kind, served, in the end, to give safe and satisfactory indications of the water-level. An old injector was rebuilt, with some success, to suit the thirty and more atmospheres pressure, and this was, in the end, superseded by a Worthington, high-pressure, duplex pump, which has proved entirely successful. The steam-gauge was tested to 1,000 pounds pressure, and standardized by a mercury column and the Emery testing machine of the college laboratory.

The engine was tested at a great variety of pressures, from 500 pounds at the boiler downward. The accompanying combined diagram, Fig. 7, shows the action of the steam when working at 300 pounds, which proved, on the whole,

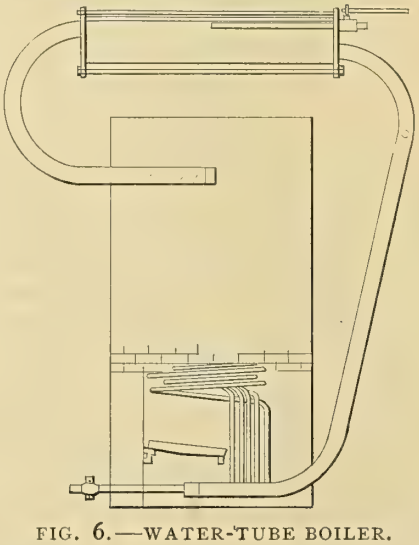


FIG. 6.—WATER-TUBE BOILER.

as economical a pressure as any. Its outer, smooth, curve is the pressure-volume curve for steam dry and saturated, and the intercepts between its abscissas and those of the expansion line of the diagram give the proportion of steam

[10] *Vide* Carpenter's "Experimental Engineering," or Thurston's Engine and Boiler Trials," and *Trans.* A. S. M. E., 1890 *et seq.*

existing, at every instant, in the engine as expansion progresses.[11]

The results of the trials made with this engine are best exhibited, for present purposes, in the diagram given in Marine Engineering, November, 1897, on page 23, "Fig. 1,"† in which *A* shows what would be the performance of the ideal engine, free from all extra-thermodynamic wastes with feed-water at 40 degrees Fahr. and steam-pressures rising from the minimum to 500 pounds per sq. in.; *B*, the actual performance of the engine with reheaters acting as effectively as was found practicable at the maximum pressure; *C*, the efficiencies when the steam was wet and no reheaters in use; *D*, the work of the engine with moderately effective reheating, and *E*, that of the machine with the most complete reduction of wastes attained in any of its trials, at that recorded with 300 pounds pressure. The curve *F* is drawn as that probably obtainable by the reproduction of this engine on a large scale, comparable with the work of the engines, of 500 to 1,000 horse-power, which have given the existing best records. This assumes the equivalent of extra-thermodynamic heat-wastes amounting to a net twenty per cent. approximately. The mechanical efficiency of the engine was between eighty-five and ninety-five per cent, varying with power developed and state of lubrication. With large engines this figure for friction-wastes has been reduced somewhat, but it is remarkably good for a small machine. The equation of these curves takes the form, as already stated,

$$W = m \log. p_1;$$

the constant, *m*, being about 18 for *A*, 25 for *B*, 30 for *C*. Large engines have already actually reduced this coefficient to 24, and it should be possible to equal this in large marine engines. With 1,100 *B. T. U.* supplied per pound of feed-water, a moderate proportion, the quantity of heat, measured in thermal units, which would be demanded, would rise about ten per cent. In the case of which the calorimetric analysis is here given, the amount supplied per pound of steam was actually 1,400, and the expenditure of heat about 13,500 *B. T. U.* per *I. H. P.* per hour. The dimensions of the principal elements of the engine, and its performance at moderate and most economical pressures, with varying conditions of re-heating, are condensed into the two following tables; made by filling out the regular blanks of the laboratory as used for this purpose. The quantity of heat per pound of steam varies, in all experiments, with variation in the quantity put into the fluid by the re-heaters and is a minimum for the curve marked *C*. in "Fig. 1,"† before

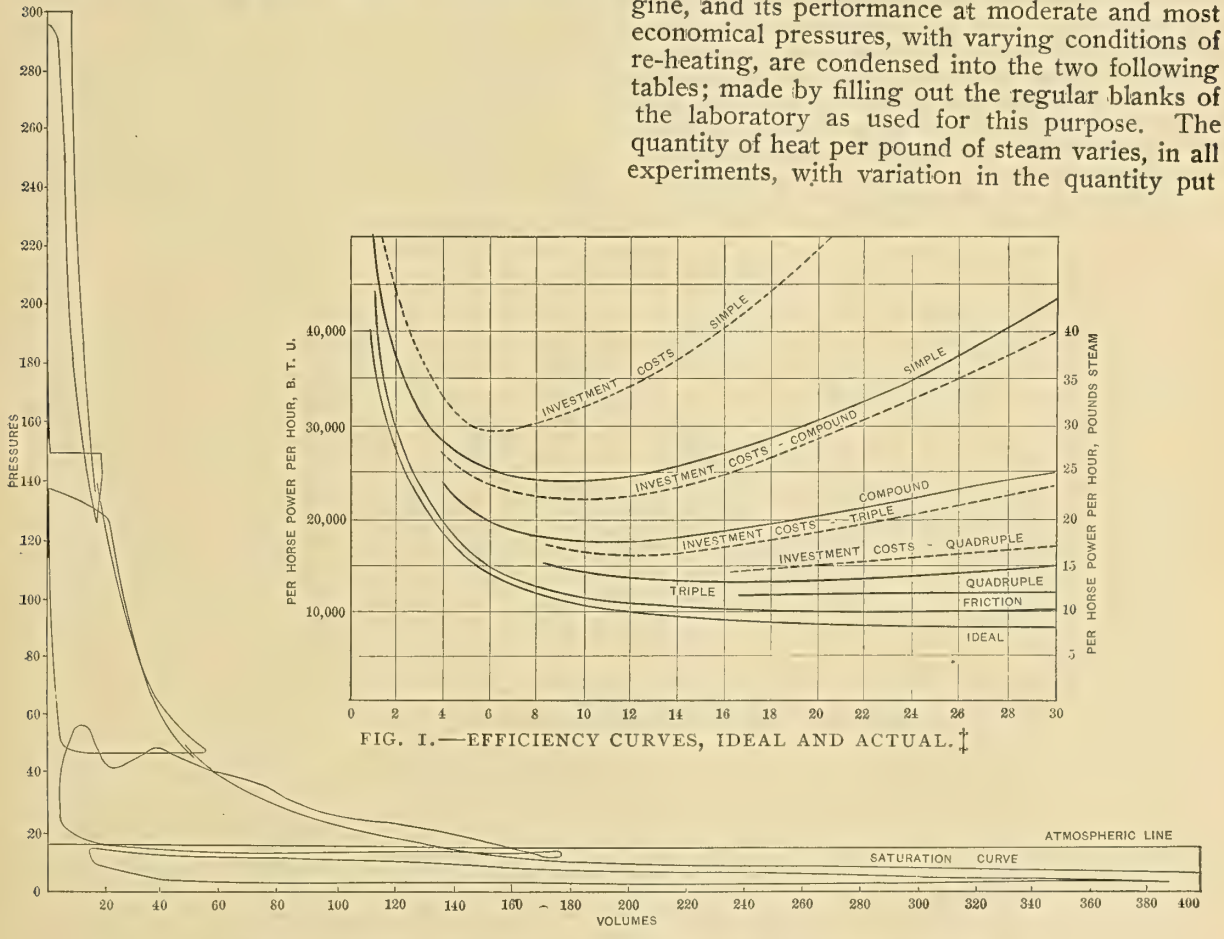


FIG. 1.—EFFICIENCY CURVES, IDEAL AND ACTUAL.‡

FIG. 7.—COMBINED DIAGRAM, QUADRUPLE-EXPANSION ENGINE.

[11] *Trans.* A. S. M. E., 1893, Vol. XV, p. 313; "The High Pressure Multiple-Expansion Engine;" R. H. Thurston.

†‡ NOTE.—"Fig. 1—Engine Efficiencies," on page 23 of November 1897, issue, should read "Fig. 8—Engine Efficiencies." and in the context "Fig. 1" should read "Fig. 8."

mentioned, and a maximum for curve *E*. The heat thus stored is largely waste heat for the boiler which would otherwise go arrangement and that of heaters and re-heaters and economizers, as well as upon the efficiency of the engine. The deficiency exhibited at the higher,

I.

SIBLEY COLLEGE, DEPARTMENT OF EXPERIMENTAL ENGINEERING.

DATA AND RESULTS. QUADRUPLE-EXPANSION ENGINE.

Built by Messrs. Hall & Treat, Sibley College, Cornell University.

			H. P.	1st I. P.	2d I. P.	L. P.
Kind of engine, quadruple expansion		Diameter of cylinder	inches	2,344	3,969	6,977	10,266
Duration of run	hours 6¼	Length of stroke	inches	4.5	4.5	4.5	4.5
Revolutions per minute	286.2	Diameter of piston-rod	inches	.5	.625	.875	1.125
Temperature condensing water, cold	degs. F. 34.87	Piston displacement crank end cubic inches		18,565	55,403	171,794	371,606
" " warm "	41.27	" " head " " "		19,449	55,710	172,395	372.6
" condensed steam	58.24	Volume of clearance, " " per cent		2.14	1.99	2.79	3.94
" engine room	73.80	" " " crank " " "		1.88	1.99	2.79	3.94
" external air	31.30	Make of indicator		Thompson.			
Boiler pressure gauge lbs.	279.2	Spring	lbs. per inch	307	186.8	20 / 30	10
Barometer, 29.154 inches lbs.	14.306	Length of brake-arm	feet	4.8021			
Condenser, 25.43 inches high lbs.	12.479	Brake-load	lbs.	55.33			
Boiling temp., atmospheric pressure degs. F.	210.75	Quality of steam at cut-off		See combined diagram.			
Total steam per hour, *C*, for engine lbs.	106.53	" " " " release		"	"	"	
Total condensing water per hour lbs.	16,632	Cut-off crank end, per cent. stroke		20.68	30.57	27.56	22.09
Wt. condensing water per pound, steam	156.15	" head " " "		26.38	36.82	31.89	31.27
Total I. H. P.	**11.095**	Release crank " " "		95.84	98.96	95.80	99.92
" D. H. P.	9.606	" head " " "		95.91	98.26	99.40	96.56
Mechanical efficiency	**86.88**	Compression crank, " "		3.4	10.	13.5	8.3
Moisture in steam per cent.	2.49	" head " "		6.77	6.27	12.8	10.
Steam per I. H. P. per hour, actual lbs.	9.51	Absolute pressure at point of cut-off lbs.		264.10	110.325	39.40	10.67
" " I. H. P. per hour, corrected, cal. lbs.	**9.27**	" " " release lbs.		115.154	44.43	14.30	4.08
" " D. H. P. " " " " lbs.	10.81	" back pressure lbs.		125.169	44.33	13.38	2.47
Water-rate of perfect engine	**6.86**	I. H. P. head		.868	1.727	1.738	1.44
Thermodynamic efficiency	**31.44**	I. H. P. crank		.804	1.534	1.771	1.621
Ratio actual to theoretical water consumption	1.38	Total I. H. P.		1.672	3.261	3.509	2.555
Heat supplied per hour B. T. U., by boiler	125,547	Steam per I. H. P. at point cut-off, per diagrams		4.86	8.60	7.71	4.071
" discharged per hour B. T. U.	109,240	" " " " " release, " "		8.99	10.94	11.72	8.912
" utilized per hour B. T. U.	28,236	Distribution of work. Total H. P. units		15.07	29.39	31.63	233
B. T. U. per I. H. P. per minute	**225.7**						
Ratio of expansion from combined card	**82.9**						

II.

SIBLEY COLLEGE, DEPARTMENT OF EXPERIMENTAL ENGINEERING.

DATA AND RESULTS. QUADRUPLE-EXPANSION ENGINE.

Trial made by N. S. Reeder, J. H. Mitchell.

			H. P.	1st I. P.	2d I. P.	L. P.
Kind of engine, quadruple expansion		Diameter of cylinder	inches	2,344	3,969	6,977	10,266
Duration of run	hours 3	Length of stroke	inches	4.5	4.5	4.5	4.5
Revolutions per minute	290	Diameter of piston-rod	inches	.5	.625	.875	1.125
Temperature condensing water, cold	degs. F. 68.95	Piston displacement crank end cubic inches		18,565	55,403	171,794	371,606
" " warm	degs. F. 83.33	" " head " " "		19,449	55,710	172,395	372.6
" condensed steam	95.38	Volume of clearance " " per cent		2.14	1.99	2.79	3.94
" engine room	96.2	" " " crank " " "		1.88	1.99	2.79	3.94
" external air	64.9	Make of indicator		Thompson.			
Boiler pressure gauge lbs.	393.9	Spring	lbs. per inch	260.6	100	30	10
Barometer, 29.27 inches lbs.	14.36	Length of brake-arm	feet	4.8021			
Condenser, 21.36 inches hg lbs.	10.48	Brake, load	lbs.	55.046			
Boiling temp., atmospheric pressure degs. F.	210.96	Quality of steam at cut-off		51.5	71.5	84	54.5
Total steam per hour, *C*, for engine lbs.	129.3	" " " " release		90.5	100	Super.	100
Total condensing water per hour lbs.	9,195	Steam, chest pressure gauge		....	....	....	....
Wt. condensing water per pound steam	71.1	Cut-off crank end, per cent, stroke		22.21	29.67	30.34	27.16
Total I. H. P.	10.634	" head " " "		26.45	34.02	33.72	31.83
" D. H. P.	9.217	Release crank " " "		100	97.27	98.51	100
Mechanical efficiency	87.22	" head " " "		100	97.52	100	97.29
Moisture in steam per cent	.94	Compression crank, " "		1.08	10.7	10.0	5.92
Steam per I. H. P. per hour, actual lbs.	12.15	" head, " "		0	4.64	7.58	8.50
" " I. H. P. " " corrected, cal. lbs.	12.03	Absolute pressure at point of cut-off lbs.		265.34	101.56	37.35	13.27
" " D. H. P. " " " " lbs.	13.89	" " " release lbs.		120.37	55.45	18.98	6.72
Water-rate of perfect engine	7.54	" back pressure lbs.		120.37	47.06	17.04	5.03
Thermodynamic efficiency	29.4	I. H. P. head		1.366	1.625	1.240	1.444
Ratio actual to theoretical water consumption	1.61	I. H. P. crank		.786	1.452	1.481	1.240
Heat supplied per hour B. T. U., by boiler	154,885	Total I. H. P.		2.152	3.077	2.721	2.684
" discharged per hour B. T. U.	140,446	Steam per I. H. P. at point cut-off, per diagram		5.10	7.50	7.65	6.12
" utilized per hour B. T. U.	27,063	" " " " " release "		9.85	11.35	12.69	10.07
B. T. U. per I. H. P. per minute	242.7	Distribution of work. H. P. as I.		20.23	28.93	25.58	25.23
Ratio of expansion from combined card	80.1						

to the chimney, and the true efficiency of the combination finally depends upon the extent of heating surface in the boiler, and its as compared with the lower pressure employed in these trials may have been due to leakage at those higher tensions; but this is not certain.

CONSTRUCTION AND OPERATION OF THE SUBMARINE BOAT ARGONAUT.

The very extraordinary submarine boat Argonaut now in the water at Baltimore, has been subjected to several practical tests lately, with an apparent large degree of success. This vessel, which we have referred to in past issues, is well shown in the accompanying photographs and scale drawing. The inventor, Simon Lake, had long in mind the construction of a boat which could not only travel under water, after the manner of other submarine boats, but could also make progress by mechanical contact with the bottom. The chief purpose in view was the recovery of treasure from sunken vessels on the coasts, using the boat as a fixed base of operations on the bottom, from which divers could work. A rough experimental boat was built by Mr. Lake about three years ago and the results then warranted the construction of the present well equipped steel boat.

The contract for the construction of the Argonaut was let to the Columbian Iron Works at Baltimore, and here the boat was put in the water last December. Her appearance upon completion is shown in the views taken shortly before the launch. The model of the boat is upon the familiar "cigar" lines, and its chief difference from the conventional form of submarine boat is the addition of wheels, two of large diameter forward (one on each side), and one of lesser size aft, occupying the place of a rudder.

Several tests of the diving, steering and locomotive powers of the boat have been made successfully during the past few weeks. During one of these, made on the Patapsco river, the boat was running on the bottom in water about up to the lights in the conning tower, when, coming to where the bottom sloped away sharply, in the channel, she dived easily, leaving only the inlet and exhaust air pipe floats in view on the surface, and after a while reappeared again on the opposite side in shallow water. During one test her speed was tried, with her conning tower showing above water, and the result was a mean of six miles an hour. The Submarine Boat Company is indeed so well satisfied with the results of these trials that preparations are now being made for wrecking operations. A tender will be built, which will be "cigar" shaped also, fitted with ballast tanks and four wheels. The tender will be used to load valuables recovered by the divers of the Argonaut, and will thus convey the treasure in bulk to the surface.

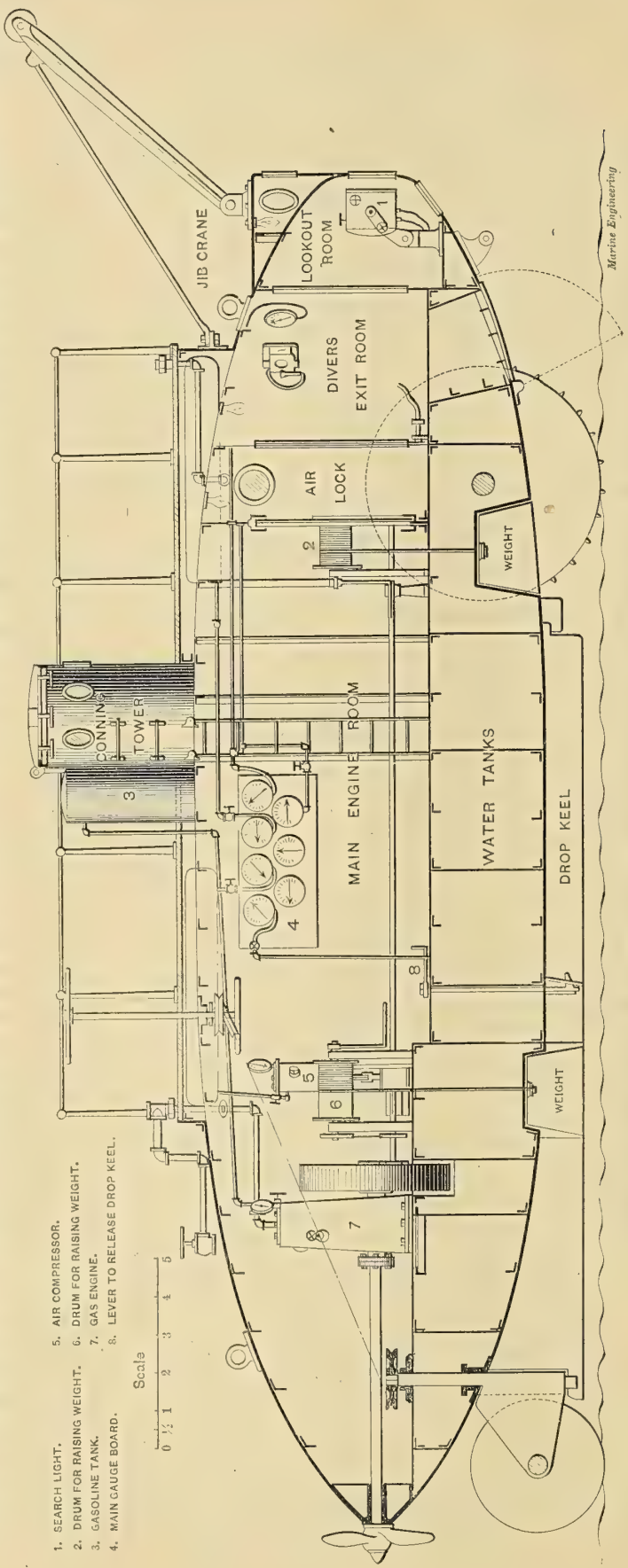
All the operations of the boat can, of course, be carried out only in a depth of water not too great for her strength. This is well within the point of collapse.

In general dimensions the Argonaut is 36 ft. long over all, 9 ft. maximum dia., tapering at each end to about 10 in. dia. She has a displacement of about 68 tons and a maximum of about 15 tons reserve buoyancy. The propelling power when floating is furnished by a White & Middleton gas engine of 50 H. P., driving a single screw 36 in. dia. and 30 in. pitch. This engine is also used by means of frictional gear to operate the dynamo, supplying current for sixteen 16 C. P. incandescent lamps, used in lighting the interior, and also current for a powerful search light located in the nose or lookout-room. The gas engine also supplies power for the air-compressor, raising and lowering of weights, and in turning the two forward traveling wheels for locomotion on the bottom. The interior arrangements are clearly shown in the drawing, but a description of the fittings will be of interest.

Starting from forward aft, the first compartment, the nose, is used as an under-water pilot house. Two lights are arranged on an angle, one on either side of the pilot, one directly ahead, and a fourth overhead. These are in addition to the search light, the rays of which can be projected in any direction forward or to the sides by the pilot. The question regarding the penetrative power of the search light rays has hardly been settled yet, but it is estimated that about 20 ft. to 25 ft. is the maximum. This, however, is considered sufficient for safety as, of course, obstacles are not very numerous when traveling submerged. In this compartment there is also an electric telephone, by which conversation can be carried on with the main engine room, and also with the diver who may be at work outside of the boat. Normal air pressure is supplied from the main compartment, as is also the current for the search and incandescent lights, all these connections being led through the bulkheads in stuffing boxes. The compartment next is the diver's operating room used in passing to and from the boat. This room, like the lookout room, is supplied with incandescent lights, electric telephone, and air pressures from the main engine room. It also contains the diver's appliances, rubber tubing and ropes and a connection to which the diver attaches his supply hose, and through which he receives normal pressure from the main operating room. When the diver is in readiness to go out the doors are sealed and the pressure in the room brought up to the outside water pressure; the door in the bottom of the boat is then unclamped and dropped down, and the pressures being equal the water does not enter the room. The diver uses the steps on the hull and door for convenience in passing to and fro. Besides the air tubing, he is supplied with a length of cable by which he can telephone to the main operating room. When re-entering the compartment the diver raises the door by a tackle, and having clamped the door securely the pressure is reduced to the normal; the diver then returns to the main operating room. The next compartment is simply an air lock lighted by an incandescent light and fitted with water-tight doors at both bulkheads.

Next aft is the main engine or operating room containing the machinery or vitals of the boat.

This room takes up the largest part of the boat, as will be seen on the profile inboard. Starting from the forward end of the space, there is fitted on the port side a cable drum used in raising and lowering the forward weight, another such drum being located in the after part of the room for the after weight. These weights are about 1,000 lbs. each and are used to pull the boat down to her desired depth. When on the surface the desired locality is attained, and everything being made ready for a trip to the bottom the two weights are lowered, by means of brakes on the drums, to the bottom; the distance the weights drop is registered by an ingenious device, and the depth is accordingly known for that spot. The buoyancy of the boat is then reduced until her reserve buoyancy is somewhat less than the combined weight of the weights. The cable drums then come into play again, as by winding up on them, either by hand or making connection with the gas engine, the boat will descend bodily provided both drums are wound equally as fast. The change in trim is noted by a pendulum near the gauge board. The boat descends until it comes to rest on the bottom with the weights in their original places. The next point of interest in the main room is the gauge board, also situated on the port side, about amidships. On this are located all the gauges, pressure, vacuum, air supply and exhaust, all regulated by valves in the vicinity. On the starboard side amidships just opposite the gauge board there is an electric switchboard and also an appliance telling the quantity of water let into the ballast tanks. The switchboard controls the search light in the lookout room, all the incandescent lights, and on it is also situated the telephone of the main room, connecting with the lookout, the diver and with the surface if necessary. On the same side just a little aft is the dynamo, which is operated by means of friction gear from the gas engine. The air compressor is on the port side opposite the dynamo. It is a special design of the inventor and is capable of storing air to 1,000 lbs. per sq. in. in the four tanks located in the superstructure, two forward and two aft as shown in the sketch. This compressor is also operated by the gas engine. Just abreast the compressor, but about the center of the boat, is the after cable drum before referred to. On the flat just forward of the cable drum a lever connects by a rod to a pawl for releasing the drop-keel. The drop-keel is simply a portion of

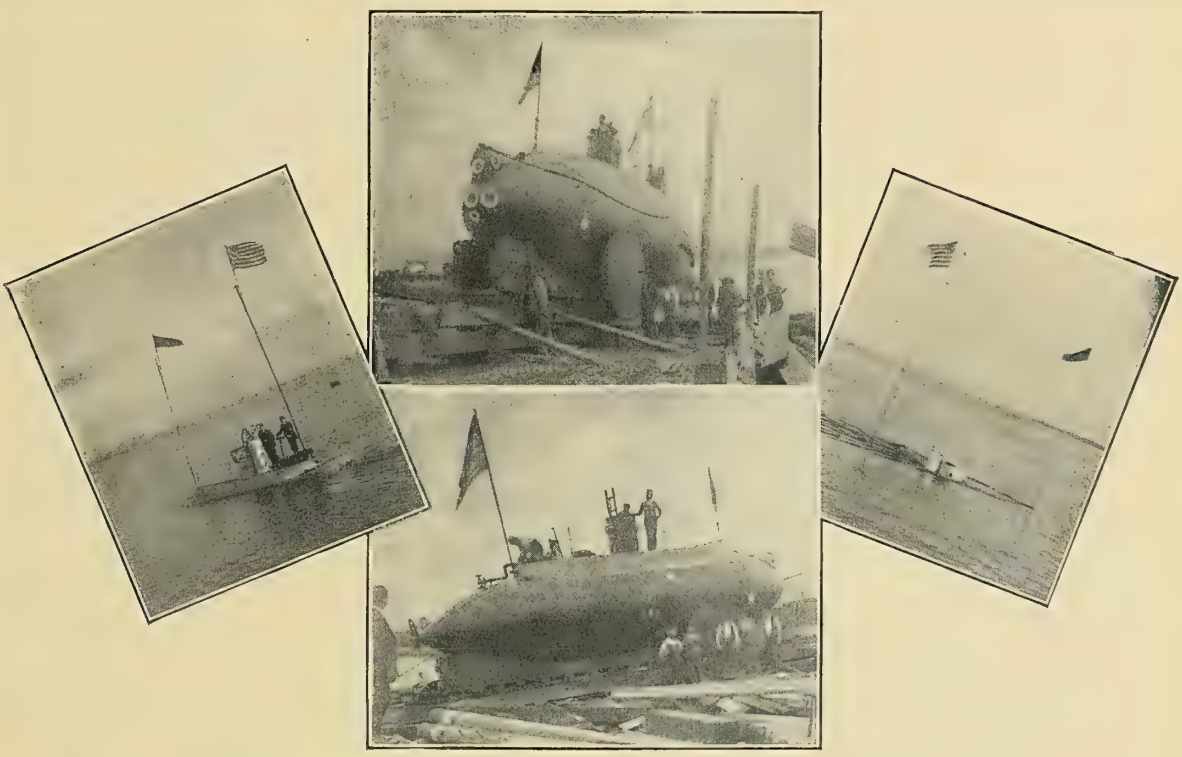


INBOARD PROFILE OF THE "LAKE" SUB-MARINE BOAT ARGONAUT, AT BALTIMORE.

the main keel and weighs about two tons. One end has a toe, which enters a recess in the fixed keel and in the other end is a slot to receive the pawl. The drop-keel is only for emergency use, in case something happened to the machinery or working part of the boat, and it became absolutely impossible otherwise to reach the surface when the boat was on the bottom. The lever referred to is turned and the pawl releasing one end of the drop-keel the other end drops out of the recess, and the boat, being two tons lighter, immediately ascends to the surface. After dropping the keel the location of it can be fixed by means of buoys or otherwise, to be recovered afterward. As it is a simple iron casting, however, its loss would not be serious.

Next, and perhaps the most important fixture of the boat is its motive power, in this case a gas engine, located in the center of the boat aft of the air compressor. It is of 50 H. P. and is supplied by a gasoline tank placed above the superstructure alongside and aft of the conning tower. The exhaust and air supply are fitted at each end of the superstructure, the former at the after end and the latter forward. The connections consist of hose nozzles made with great regard for water tightness at high pressure. Wire wound hose is used for both exhaust and supply, capable of withstanding the pressure at the maximum depth. The free end is kept on the surface by a special float designed to prevent waves or rough water from creating an inflow. Thus a fresh air supply is always guaranteed, and the exhaust is free to pass out unobstructed, and a constant circulation of fresh air through the boat is created. When on the surface these lengths of hose are coiled on the deck of the superstructure.

Abaft the gas engine comes the tail shafting and rudder head. The rudder, as will be seen in the sketch, is a combined affair, being used as a third wheel when running on the bottom, and also as a guide wheel. Chain leads are run out to the side of the hull over sheaves and thence up under the hull forward of the air compressor by means of other sheaves. A steering wheel is in place on the superstructure and another one under the shell near the compressor, one for surface work and one for under-water travel. The various pipes, valves, and gauges, in and around this compartment, are connections for air, water and gasoline supply, and are chiefly operated from the main gauge board. There is a ladder going up into the conning tower which is the main companionway of the boat. Beneath most of the compartments there are water-ballast tanks, with valves for flooding, and air pipe connections for discharging the water. In the conning tower there are five lights, and in the cover screw clamps for watertightness.



THE "ARGONAUT" BEFORE LAUNCHING AND WHEN RUNNING WITH HULL SUBMERGED.

The superstructure is a very light affair and is planked over to give deck room, having a rail around supported by stanchions.

Forward and aft on the hull are towing or mooring eyes and a crane is in position over the nose and stayed on the forward superstructure. The power is supplied from the gas engine operating a drum forward. This crane is for handling heavy wreckage.

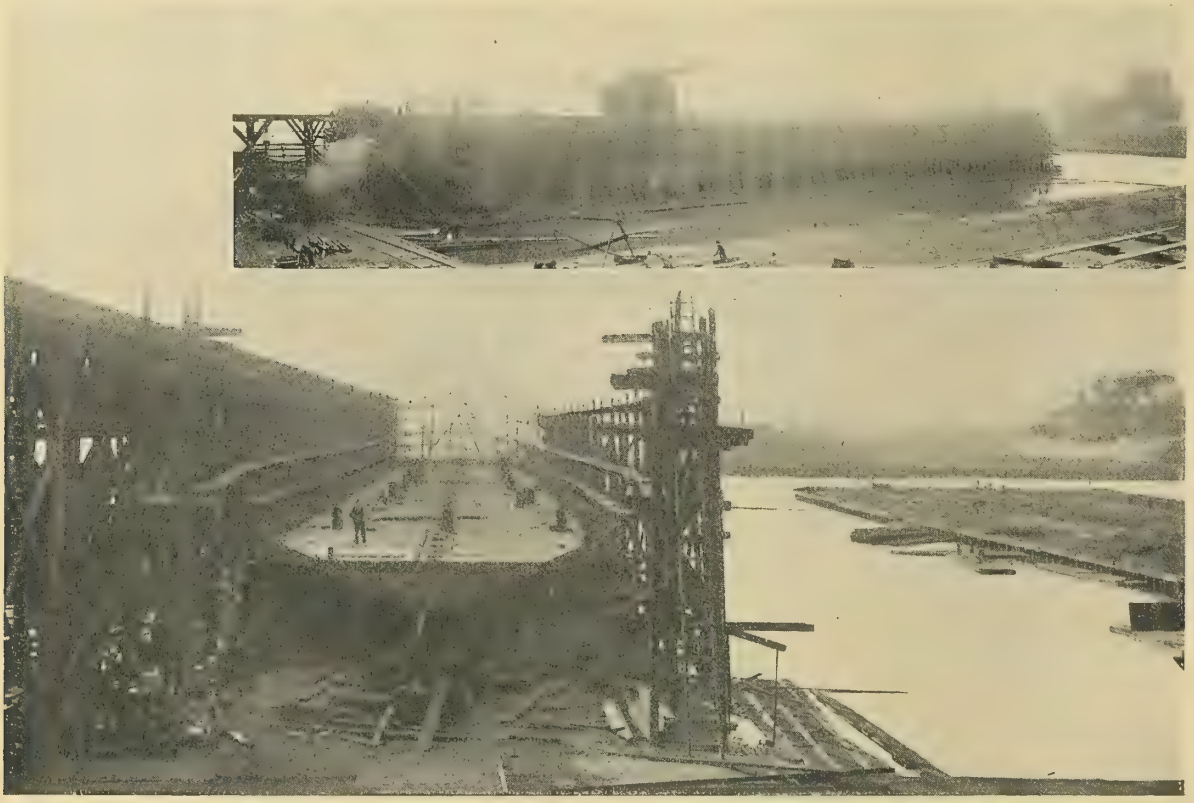
In the operation of the boat submerged, after the bottom has been touched by winding in the wire cable before described, the weights take their original positions and the boat is ready for "rolling along." The wheels forward are rotated by means of chain gear from the gas engine, and progress is made either with the propeller revolving or without. Five miles an hour was made on the bottom of the Patapsco river, which is very muddy, and it is expected that she will make much better time on a hard sand bottom. If the operator desires to return to the surface slowly he unwinds his cable drums and the boat ascends, leaving the weights on the bottom. On the surface her buoyancy is increased by discharging water and the weights are then drawn up again and she is ready to proceed. If the operator desires to come speedily to the surface he discharges water from his tanks, enough to overcome the weight of the two weights, and the boat rises instantly. In case of emergency, he uses the drop-keel to bring him to the surface.

Mr. Lake, the inventor and patentee, is a native of Pleasantville, N. J., where he was born in 1866. For many of the foregoing particulars we are indebted to the professional aid of George H. Wilson, of Baltimore.

It is probable that the first practical use to which the boat will be put is the recovery of about $30,000 in bullion, which went down in the "New Era," in 1854, off Asbury Park. The wreck lies in about 40 ft. of water.

Largest Tow Barge on the Great Lakes.

The accompanying photographs show the barge Australia on the stocks in the yard of builders, the Chicago Ship Building Company. She is a single decked tow barge for bulk freight only, and is the largest of her type on the lakes. Her dimensions are: Length over all 388 ft.; length on keel, 376 ft.; beam, molded, 48 ft., and depth 26 ft. It is estimated that she will carry 5,800 gross tons on 17 ft. draught. Her keel was laid on August 7 last and she was launched November 27. She has a 4 1-2 ft. double bottom for water ballast; twelve cargo hatches and three short masts without sails. She is provided with two stockless bower anchors and one stockless kedge, a steam capstan windlass, a steam capstan aft and a steam deck hoister amidships. Steam is supplied by an 8 ft. by 8 ft. single-furnace Scotch boiler, carrying 125 lbs. steam. Steering is effected from a pilot house amidships by a steam steering gear, and there is also hand gear fitted. Accommodations for the crew are in the half top-gallant forecastle and in wooden houses amidships and aft. The Australia is owned by James Corrigan, of Cleveland, and will be towed by some steamer of his fleet. One of the photographs was taken when the inner bottom was all in and the brackets in place to receive the lower ends of the side frames; the other when the hull was complete and ready for launching, except some riveting at the ends. She was put into the water several weeks ago.



TOW BARGE AUSTRALIA WHILE UNDER CONSTRUCTION AT CHICAGO SHIPBUILDING CO.'S YARD.

Condition of U. S. SS. Kearsarge and Kentucky.

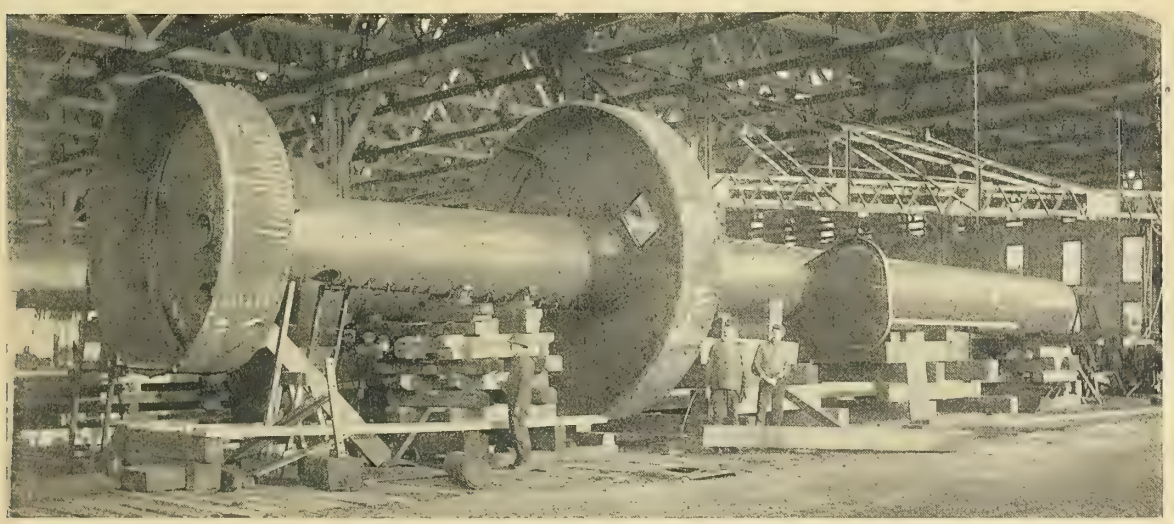
According to present plans the big battleships Kearsarge and Kentucky will be put into the water by the Newport News Shipbuilding Co. about the first of next month. Structural work is very far advanced on these two ships, though after the launch it will take a considerable time to install the machinery and fit them out for sea. Finishing touches are now being put on the launching ways at the yard. These are very massive and extend out into the water 106 ft., there being now 11 ft. of water over the farther end of the ways. The ways are fastened securely to the rows of piling underneath by chains and

ROW OF BOILERS FOR U. S. BATTLESHIPS IN SHIPYARD AT NEWPORT NEWS.

inside. There are also the customary temporary machine shops on board, all the tools being driven by electric motors taking current from the power house up the yard. The tools include punches and shears, emery wheels, pipe-screwing machines and drill presses. There are also tool rooms in each vessel, so that much time is saved which would otherwise be lost by workmen going to and from the main shops.

The big ships will be launched with the end armor plates only in place, and they will probably go into the water without the propellers, but with the fighting tops in position.

In the erecting shops the engines for the twin screws of the ships are now up. They make a fine showing, being of very symmetrical design and finished with laborious care. The engines of one of the ships have been turned over by connecting the jacking engine with the shop steam main. The degree of care which is taken in the



RIVETING UP THE MILITARY MASTS FOR U. S. BATTLESHIPS AT NEWPORT NEWS.

ring bolts coupled with turn buckles. Large gangs of skilled mechanics are hard at work in the ships, aided by every modern appliance. Pipe lines for compressed air are laid alongside the vessels and scores of pneumatic tools are in use

construction of the machinery is plainly shown in the case of the manganese bronze propellers, the blades of which are ground approximately true with an emery wheel.

The company is going ahead with the preparations for finishing the ships. In the yard the big electric crane is assuming shape, and orders have been placed for flat cars, each capable of transporting a weight of 100 tons to any part of the yard, where tracks are laid.

General Superintendent Sommers N. Smith and his assistant, George Clarke, are already considering how they will take care of the tremendous crowd which will assemble at the launching.

DESCRIPTION OF THE NEW STEAM YACHT FOR COLONEL OLIVER H. PAYNE.

A contract for the construction of the largest steam yacht ever built in this country was made since our last issue, between Colonel Oliver H. Payne, of New York, and the Bath Iron Works, of Bath, Me. Colonel Payne last year chartered W. A. Slater's steam yacht Eleanor, which was constructed by the Bath Iron Works in 1893-94. Even at the present day she has the distinction of being the largest American built steam yacht afloat. She is a large seagoing craft of great cruising power and good speed and besides being fitted with an engine of 1,200 I. H. P., she spreads 13,500 sq. ft. of canvas. Colonel Payne was so pleased with the performance and general design of the Eleanor that when he decided to build a large vessel for himself he gave her builders, the Bath Iron Works, an opportunity to submit a design, and price, on a vessel which was to be superior to any pleasure craft at present afloat. English designers also were given an opportunity to submit plans, the owner's requirements being that the vessel should be capable of making long ocean cruises. This called for an unusually strong construction with heavy scantlings judiciously arranged to withstand the greatest wave strains and the pounding of the heaviest seas. The speed guaranteed was to be 15 knots an hour at sea in ordinary weather. No large reception rooms were desired, but plenty of deck room, for Colonel Payne is a sailor rather than a passenger aboard ship. Before the contract was let a number of competitive designs by home and foreign designers were examined.

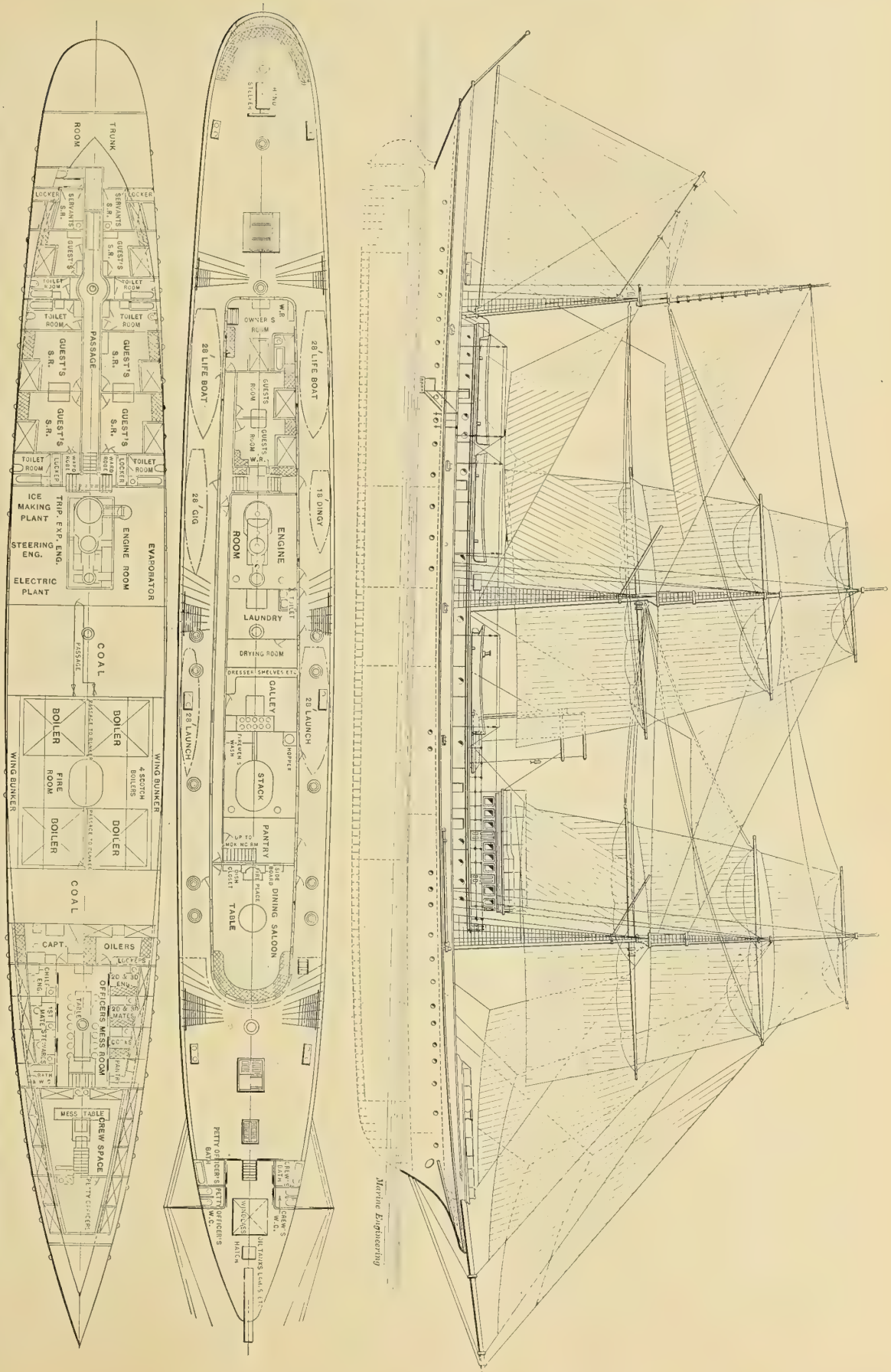
All the British designers, it is said, adopted twin screws in their plans. Charles R. Hanscom, designer and general superintendent of the Bath Iron Works, decided to use a single screw. He also designed a vessel with two-thirds sail power, so that the canvas could be used for steadying her in a seaway and in any emergency, such as a breakdown of the machinery, it would enable her to make fair speed. Unlike Mr. Watson's designs, in which the deckhouse extends the whole width of the ship, making an apartment as large as that of a country house, the Bath Iron Works' design shows a deck space of over 6 ft. in the clear between the rail and the house on either side. This somewhat narrows the rooms, but has the compensating advantage of a clear view forward, from the quarter deck, the length of the ship, instead of a vista of deckhouses, and also gives an unbroken promenade from stem to stern. The top of the deckhouse runs out to the rail, thus forming a shade deck, which answers the same purpose as awnings and at the same time makes a spacious unbroken promenade above. The Bath Iron Works' design conformed with Colonel Payne's idea of what a cruising yacht should be, and so the contract was signed.

Glancing at the general designs of the vessel, the well proportioned barque rig makes a favorable impression. About 17,000 sq. ft. of sail can be spread, so in a long cruise fires can be banked and good progress made by sail alone, by way of variety.

The general dimensions of the new vessel, which will be the largest, speediest and most luxuriously fitted ocean-going steam yacht ever constructed in this country, are as follows: Length, over all, about 301 ft.; length on load water line, 258 ft.; beam on load water line, 35 ft. 6 in.; molded depth at side, 21 ft. 4 in.; depth of hold, 20 ft.; mean draught, 15 ft.; draught aft, 15 ft. 9 in.; approximate gross tonnage, 1,300 tons. It will be noticed that the vessel has a round stern instead of the usual square stern now so common, especially with British steam yachts. This round stern was desired by Colonel Payne, and viewed from a position astern of the vessel, it will have a neat look. The yacht is a graceful, handsome, "shippy" boat. Though a powerful vessel, she has not that heavy appearance which seems to be characteristic of many modern full-powered steam yachts.

The machinery and coal spaces occupy 96 ft. of the vessel's length. Forward of the machinery space on the lower deck are the quarters for the officers and crew. At the extreme forward end a trimming tank extends to the lower deck, with a watertight compartment above this extending to the main deck. Abaft of this is a room 15 ft. long fitted so as to accommodate fifteen petty officers. The crew's quarters, sailors and firemen, is just abaft the petty officers' room. It is a commodious, airy and well lighted room, about 20 ft. long and the full width of the ship. It will be fitted with 24 berths, mess tables, dish closets, wash stands, drawers and other fittings. All berths for the crew will probably be made of pipe, with wire mattresses and sides. A companionway, common to both crew and petty officers, leads from the main deck at the aft end of the forecastle. The remainder of the space on the lower deck forward of the machinery is devoted to the ship's officers. A large mess room, 27 ft. long and 12 ft. wide, six average sized state rooms, two very large state rooms, with a bath room and pantry, are very well arranged in a fore and aft length of 36 ft. These rooms will be

PLANS OF THE SINGLE-SCREW STEAM YACHT FOR COLONEL OLIVER H. PAYNE, UNDER CONSTRUCTION AT THE BATH IRON WORKS.



finished in cherry and ash, with first-class furnishings. The two large state rooms are aft of the mess room; the one on the starboard side is the Captain's room, while the port room is fitted up to accommodate six oilers. The Captain's room will contain a full size bed, lounge, bureau, wardrobe, washstand, lockers, and a concealed bath and water closet. The remaining six state rooms are for the Chief Engineer, two assistant engineers, two mates, steward and cook. The entrance to the officers' mess room is located at the forward end by means of an adjustable stairway and square companion.

Abaft the after engine room bulkhead the space on the lower deck is devoted to the accommodation of the owner's guests. A passage about 4 ft. wide runs the entire length. The two forward state rooms on each side are unusually large, being about 14 ft. square. The two remaining guests' rooms are about 10 ft. square. There are also four large bath and toilet rooms, two 7 ft. long, and two 5 ft. long, each being the full width of the ship from the passage bulkhead to the side of the vessel. Two servants' rooms, 9 ft. long, each containing two berths, with a large bath room—common to both—are placed abaft the guests' rooms, the passage being bulkheaded across, communication being afforded by means of two swinging doors. The aft space on the lower deck will form a trunk and baggage room. The general arrangement, joiner work, silk tapestry, upholstery, furnishings and finish of these guests' rooms will be unexcelled, and will present a most magnificent appearance. At the present time, however, it would be out of place to attempt any description in detail of what as yet exists only on paper or in the minds of the owner and designer.

Colonel Payne's suite of rooms is on the main deck in the after part of the deckhouse. It consists of three state rooms and toilet room. The private room is a fine roomy apartment 16 ft. long by 15 ft. wide. Two other state rooms are about 10 ft. 6 in. long by 12 ft. wide. In the furnishing of these rooms expense will not be considered, and all this work will be done under the owner's direct supervision. The yacht will have no social hall, large saloon or reception hall, but an extra large dining saloon 30 ft. long and 18 ft. wide, fitted up most luxuriously, will occupy the forward part of the deckhouse. Abaft of this will be a stairway leading to the promenade deck above. Then comes a pantry, fire room hatch and a commodious galley. Amidships are located a large steam laundry, drying room and a deck water closet. Between the engine hatch casing and the owner's suite of rooms is the stairway leading below to the guests' rooms. Communication in bad weather between the dining saloon forward and the owner's and guests' accommodation aft is obtained by means of a passage in the starboard side of the deckhouse.

The deckhouse, which has large sliding round air ports, will be constructed of steel, sheathed with handsomely paneled mahogany. The total length of the deckhouse is 155 ft. A forecastle deck is fitted forward and this forms an excellent covering for a Hyde steam capstan windlass, besides affording a most desirable location for the petty officers and crew's bath rooms and water closets. Above the deckhouse on the forward promenade deck come the chart house, captain's office and bridge room, also a commodious, airy smoking room. Six boats will be carried on this deck, viz., two 28 ft. life boats, two 25 ft. launches, a 25 ft. owner's gig and an 18 ft. dingy.

The lower masts and yards will be of Oregon pine, the bowsprit will be of steel, and the remainder of the spars will be of spruce. A capstan is fitted on the forecastle deck, connected to the windlass, and on the quarter deck aft is located another steam capstan, with the engine below the main deck.

The machinery consists of a vertical inverted direct-acting, triple-expansion engine, the cylinders being about 28 in., 44 in., and 70 in., dia. with a common stroke of 38 in. The surface condenser will be of brass, cylindrical in form, the cooling surface being about 3,600 sq. ft. With about 130 revolutions this engine will indicate about 3,000 I. H. P. The propeller will be of manganese bronze, four bladed, of the built up type, the dia. being about 13 ft. Steam will be supplied by four large single-ended Scotch boilers, built for a working pressure of 165 lbs. per sq. in. These boilers will be about 14 ft. dia. and 12 ft. 6 in. long, and as each will have three 44 in. corrugated furnaces, the total number of furnaces will be twelve, so that about 250 H. P. per furnace will be developed with natural draft. The grate area of each boiler will be about 80 sq. ft., giving a total grate area of 320 sq. ft. for all four boilers. The total heating surface will be about 10,500 sq. ft. Owing to the boiler power being divided into four units, no donkey boiler will be fitted. In the engine room the most modern improved ice making machinery will be located, also an evaporator, electric plant in duplicate, and a steam steering engine. The vessel has two large athwartship coal bunkers, one forward and one aft of the boiler room, there being but one fire room, as shown in the general arrangement sketch. The forward bunker has a capacity of 140 tons of coal, and the amidship one will hold about 280 tons. There are also wing bunkers running the whole length of the boiler room, and these will bring the total coal bunker capacity up to 480 tons.

A passageway through the amidship bunker connects the fire room and engine room. In the after hold an electric storage battery will be fitted with a capacity sufficient to light the entire vessel for about 12 hours. Six large fresh water tanks are located just forward of the aft peak bulkhead, with a total capacity of over 30 tons of fresh water. The remain-

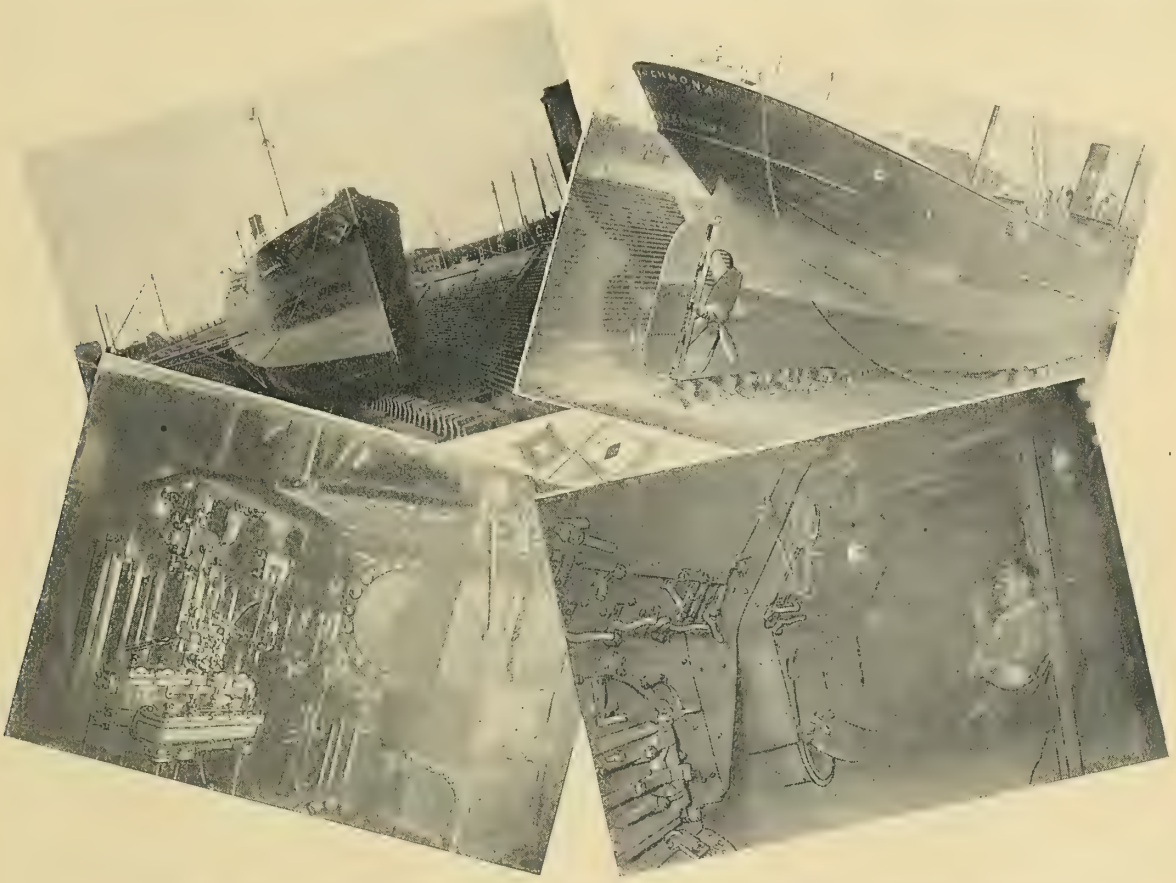
der of the after hold is subdivided into engineer's stores, cabin stores, ice making room, wine room and armory. In the forward hold are located the cold storage rooms, with separate rooms for meat, fish and fowl. The remainder of the space in this hold is occupied by chain lockers, general stores, provisions, boatswain's stores and sail rooms.

A double bottom forming water ballast tanks is worked in the forward and after holds, but not in the machinery spaces nor in the extreme ends of the vessel. The subdivision of the hull is first class, as the vessel is fitted with seven complete transverse bulkheads.

The speed of the yacht will be 15 knots, or nearly 17 1-2 statute miles per hour at sea, in ordinary weather under steam alone with natural draft. Assisted or forced draft will probably be fitted later. The latest British built steam yachts of this size are credited with a speed of about 16 knots at full power, but it must be remembered that this is a trial trip speed under forced draft, and such results are seldom, if ever, attained again even under the most favorable circumstances. These boats have a sea speed of about 14 knots to 14 1-2 knots per hour. The new yacht will, therefore, be a speedier vessel than the latest British designed steam yacht, for when assisted by her canvas, or by a slight air pressure in the stokehold, the speed will be increased to about 17 knots per hour. At a cruising speed of 12 knots per hour, Colonel Payne's yacht will have a radius of action of over 5,000 knots, and she will have abundant coal to enable her to cross the Atlantic at full speed.

Machinery Equipment of the S. S. Inchmona.

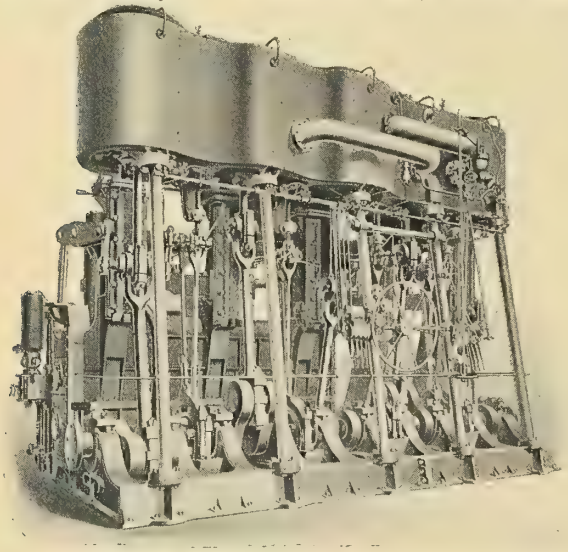
An interesting freight steamer, the Inchmona, loaded in New York harbor last month for the American and Indian S.S. Line, which has just been established for the direct shipment of cargo to East Indian ports. This steamer lays claim to the title of most economical freight carrier afloat. She was launched in 1896, at West Hartlepool, on the east coast of England, and attracted a very considerable amount of attention in the technical press everywhere on account of her equipment and trial record. We here publish several exterior and interior views from photographs taken while the vessel was at the yard of the Erie Basin Dry Dock Co., Brooklyn, where she was made ready for the long voyage.



VIEWS OF THE HULL AND MACHINERY EQUIPMENT OF THE FREIGHT STEAMER INCHMONA.

The Inchmona is 335 ft. long, over all; 46 ft. 7 in. beam, and 15 ft. 2 in. deep. Her tonnage is 3,215 gross, and 2,223 net. She is fitted with

water ballast tanks holding 1,061 tons and carries 330 tons of coal in her bunkers. As will be noticed in the views, she has very full lines, a perfectly flat bottom, and is fitted with bilge keels. Her machinery is of the most modern type, designed to give maximum efficiency at minimum expense of operation. The main engine is of the five-cylinder, five-crank, quadruple expansion type, with cylinders 17 in., 24 in., 34 in., and two 42 in. dia. and 42 in. stroke. The design is quite modern, including wrought iron front columns, built up interchangeable crank shaft, with eccentrics on couplings, single slide cross heads, and Stephenson double bar link motion. The valves are in the center line of the cylinder, the high pressure a piston valve, and the others slide valves. The condenser extends along the back frames, the length of three cranks, and carries the reversing engine on its top, so that the front of the main engine is clear of everything except the starting gear. The air pump and bilge pumps are worked by levers from the L. P. cross head



FIVE-CYLINDER, FIVE-CRANK, QUADRUPLE-EXPANSION ENGINE OF S. S. INCHMONA.

in the usual style. The separate units of the engine are carefully balanced, and this with the five cranks gives a very even rotative effort, there being ten impulses at regular intervals during each revolution. The exact figures on horse power are not obtainable, but from available data it figures out about 1,050 I. H. P. It is doubtful, however, if any advantage is gained by this type of engine, as it is of great size for the power developed, and the multiplicity of working parts bespeaks a considerable extra first cost and after expense for upkeep. There are two single ended Scotch boilers, each fitted with two small furnaces. The working pressure is about 250 pounds per sq. in. The construction of the boilers is peculiar, in that the ends are flat plates riveted to flanges on the shell. The Ellis and Eaves system of hot draft is used and the boilers are also fitted with Serves tubes. A superheater is fitted in the uptakes, and there is a special Weir's system of hot feed by which as high a temperature as 400 deg. F. has been reached. At sea with a full cargo the Inchmona averages 9 knots, on a consumption of about 13 tons of best Welsh coal. When she came out a record of .999lbs. of coal was generally conceded.

On her trip from here, which commenced January 6, she carried steel rails, petroleum, domestics and miscellaneous cargo. Norton & Son, of New York, the general agents of the line, expect to maintain a thirty days' service.

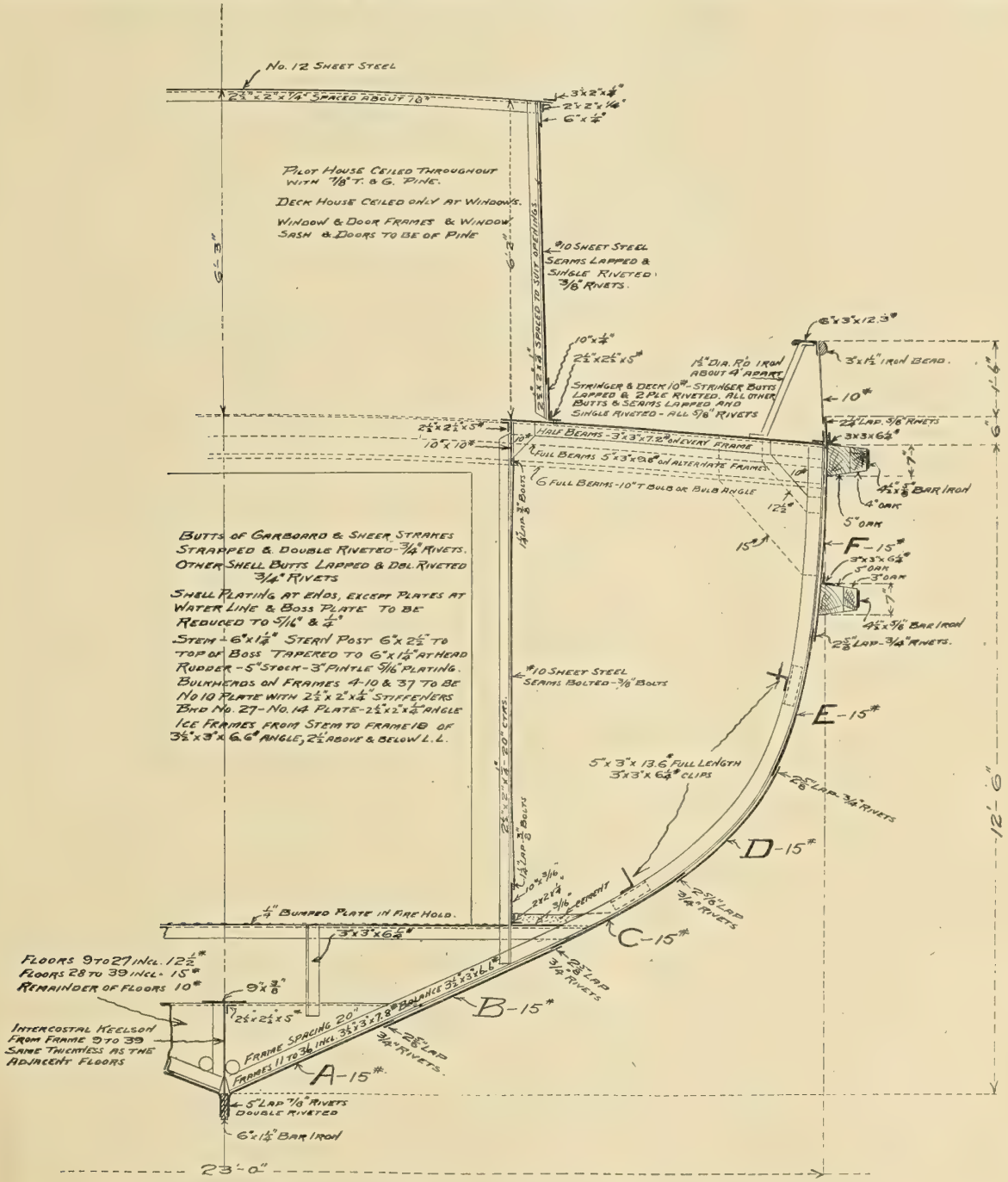
New Boilers for the S.S. La Grande Duchesse.

Work was commenced last month tearing out the water-tube boilers of the Plant Line steamer La Grande Duchesse, to make room for the installation of Scotch marine boilers, which has been decided upon. The vessel is now lying at the builders' yard in Newport News, where the new boilers will be constructed. Up to the time of the removal of her boilers, which were of the Babcock and Wilcox make, the La Grande Duchesse had the largest equipment of water-tube boilers of any American seagoing vessel. There were eight Babcock and Wilcox boilers set back to back on the keel line, with the fire rooms against the sides of the ship. These boilers were fitted with tubes 4 in. and 2 in. dia., and 7 ft. 3 in. long of charcoal iron expanded into hydraulic forged steel headers. They were adapted to forced draught and a working pressure of 225 lbs. per sq. in.

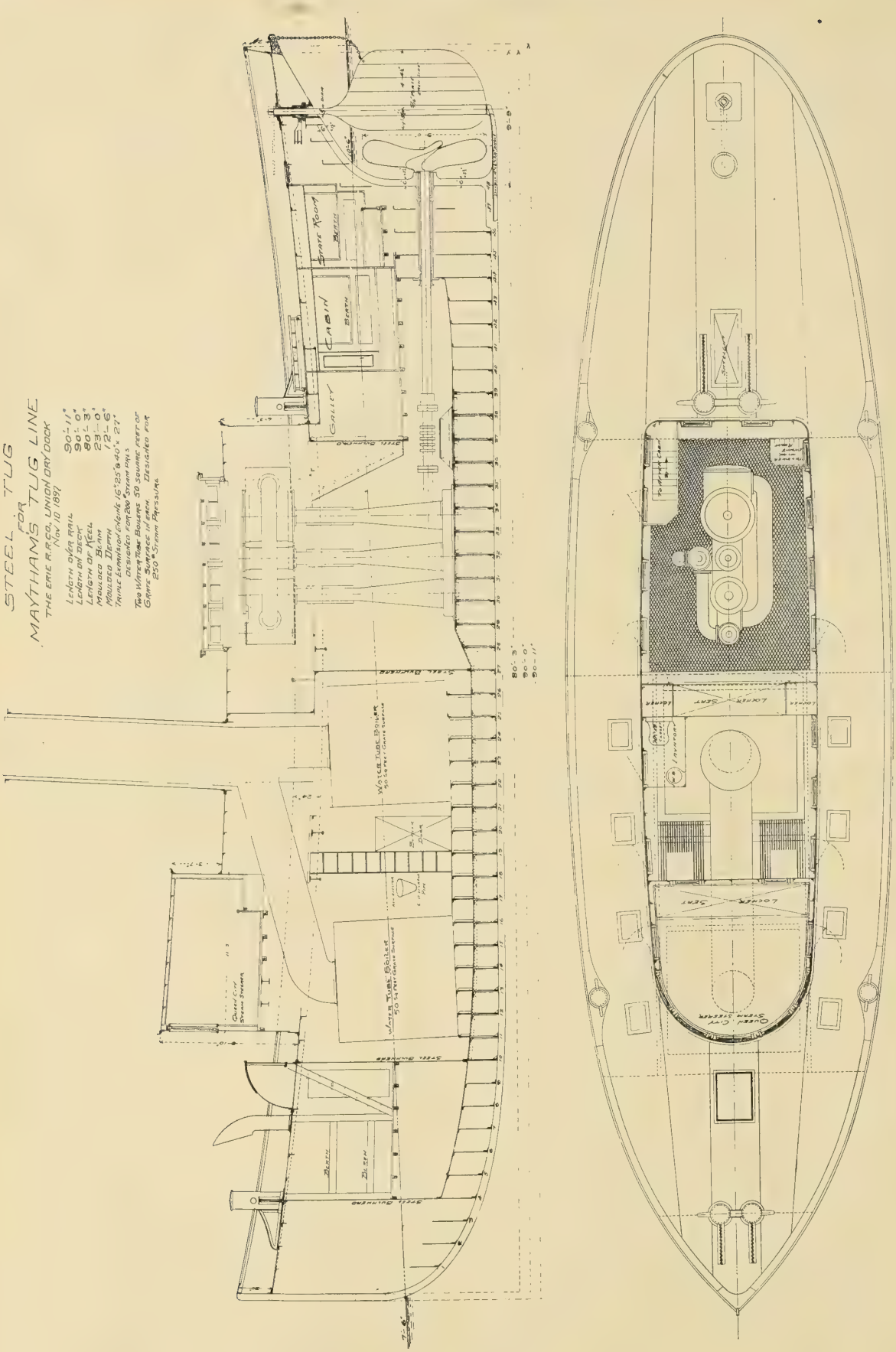
The new Scotch boilers will be the heaviest job ever undertaken in this country, and the plates are now being specially rolled. There will be two double-ended boilers 15 ft. 3 in. dia. and 20 ft. long, and two single-ended boilers 15 ft. 3 in. dia. and 11 ft. long, built for a working pressure of 210 lbs. The shell plates for these boilers will be of the tremendous thickness of 1 5-8 in. They will be fitted with Fox corrugated furnaces and plain tubes with retarders. A complete equipment of Ellis and Eaves induced draught will be fitted with the boilers. The double-ended boilers will each weigh over 100 tons, or as much as the heaviest locomotive ever built for freight traffic. The boilers will be placed across the keel line so that the fire rooms will be athwart ships, and the present smokestack will likely be retained. The La Grande Duchesse, which has been running on the Savannah line during the summer, is 404 ft. long over all, 47 ft. 9 in. beam and 37 ft. 4 in. deep. She displaces about 5,600 tons on a mean draught of 17 ft. 4 in. She has accommodation for 700 passengers and 3,000 tons of freight. The propelling machinery consists of two sets of quadruple-expansion engines, with cylinders 24 in., 34 in., 48 in., and 68 in. dia., and 42 in. stroke. The screws are 14 ft. 6 in. dia. and 18 ft. pitch, and the vessel has a sea speed of 17 knots.

Details of a Modern Type of Lake Tugboat.

A strictly modern American tugboat now building at the Union Dry Dock in Buffalo is shown in the drawings herewith. The machinery equipment, as will be noticed, includes water-tube boilers and triple-expansion engines. The tug is building for Maytham's tug line from designs by Edward Gaskin. She is a steel boat, in dimensions: 90 ft. long on deck, 23 ft. beam molded and 12 ft. 6 in. deep molded. She is fitted with four steel bulkheads. Her displacement is 204 tons and the center of buoyancy is 2.45 ft. aft of dead flat section. The machinery equipment includes two water-tube boilers to carry a pressure of 250 pounds, each having 50 sq. ft. grate surface. The engine is of the triple-expansion type, designed to work at 200 pounds pressure, with cylinders 16 in., 25 in. and 40 in. dia. by 27 in. stroke. The weight of engines, including condenser and pumps, is 37.20 tons; weight of each boiler and water 17.125 tons, or 34.25 tons for both; weight of hull and outfit, including steam steerer, anchor chain, and other fittings, and 25 tons of fuel, is 132.25 tons.


No. 12 Sheet Steel
Pilot House Ceiled Throughout with 7/8" T. & G. Pine.
Deck House Ceiled only at Windows.
Window & Door Frames & Window Sash & Doors to be of Pine
9/10 Sheet Steel Seams Lapped & Single Riveted 3/8" Rivets.
Stringer & Deck 10# - Stringer Butts Lapped & 2 Ple Riveted. All other Butts & Seams Lapped and Single Riveted - All 5/8" Rivets
1½" Dia. Rd Iron about 4' apart
3"x1½" Iron Bead.
Half Beams - 3"x3"x7.2# on every Frame
Full Beams 5"x3"x9.8# on alternate Frames
6 Full Beams - 10" T Bulb or Bulb Angle
Butts of Garboard & Sheer Strakes Strapped & Double Riveted - 3/4" Rivets. Other Shell Butts Lapped & Dbl. Riveted 3/4" Rivets
Shell Plating at Ends, except Plates at Water Line & Boss Plate to be Reduced to 5/16" & 1/4"
Stem - 6"x1 1/8" Stern Post 6"x2½" to top of Boss Tapered to 6"x1½" at Head
Rudder - 5" Stock - 3" Pintle 5/16" Plating.
Bulkheads on Frames 4-10 & 37 to be No 10 Plate with 2½"x2"x¼" Stiffeners
Bhd No. 27 - No. 14 Plate - 2½"x2"x¼" Angle
Ice Frames from Stem to Frame 18 of 3½"x3"x6.6# Angle, 2½" above & below L.L.
#10 Sheet Steel Seams Bolted - 3/8" Bolts
5"x3"x13.6# Full Length 3"x3"x6.4# Clips
¼" Bumped Plate in Fire Hold.
Floors 9 to 27 Incl. 12½#
Floors 28 to 39 Incl. 15#
Remainder of Floors 10#
Intercostal Keelson from Frame 9 to 39 Same Thickness as the Adjacent Floors
Frame Spacing 20"
Frames 11 to 36 Incl. 3½"x3"x7.8# Balance 3½"x3"x6.4#
5" Lap 7/8" Rivets Double Riveted
6"x1¼" Bar Iron
23'-0"
12'-6"

HALF CROSS-SECTION OF STEEL TUG BOAT FOR SERVICE ON THE GREAT LAKES.



DRAWINGS OF STEEL LAKE TUG NOW UNDER CONSTRUCTION AT THE UNION DRY DOCK, BUFFALO, N. Y.

The tug is intended chiefly to tow a dump scow 175 ft. long by 25 ft. beam by 12 ft. deep, and 10 1-2 ft. draught, used for carrying 650 tons of gravel. The length of tow is about 3 miles, and portion of the course is against a 7 mile an hour current. The tug will, however, be used also for harbor towing and is designed so that she can carry 60 tons of coal in the bunkers and 10 tons on deck, when long distance towing is to be done. The dimensions of the tug were, of course, limited by the port conditions, so that it was not possible to give her greater length, and at same time the size and weight of machinery made a large beam necessary. Owing to the limitations on the length, trimming tanks could not be used forward and aft, and the limit of draught, 10 1-2 feet, made it necessary to take special care in all calculations to obtain the proper immersion and trim. Sectional drawings are here presented. In the longitudinal section, the forward position of the towing bitts, just abaft the engine trunk, will be noted, this being done to prevent a tow "getting the best" of the tug in a heavy current or in close places.

ESTIMATED WEIGHTS OF MACHINERY, WITH FORMULAE FOR SCREW AND SIDE-WHEEL STEAMERS.*—I.

BY PROF. GEO. R. M'DERMOTT.

The leading conditions to be fulfilled in the design of any steamer may be generally stated as the carrying of a given dead weight, a certain distance, within a stated time, while performing such other functions as may be peculiar to the service for which the vessel is intended (warship or mercantile) within the limitations of dimensions which are possible or which have been found, by experience, to give the best results.

In the initial stages the various steps in the solution of the problem are of a tentative nature, consisting of a series of approximations to the value of certain quantities, such as horse power, weight of hull, weight of machinery, weight of coal, etc., and the success of the designer in producing an efficient vessel is, in a large measure, dependent on the accuracy with which the above quantities are evaluated.

Confining himself within the limits set by the title of this paper, the writer wishes to present the result of some investigations which he has made regarding methods of determining the weights of machinery of steamships. Each designer has his own methods, but in the preliminary work, given the required horse power, and type of engine and boilers selected as most suitable for a given case, it is usual to make a shot at the weight of machinery on a basis of pounds—or tons—per I. H. P., or it may be that the weights of engines and boilers are estimated separately, the engines on a basis of I. H. P., and the boilers on that of heating surface, grate surface, etc., the necessary information to permit of this being done having been selected from the storehouse of his experience. In the first stages of the design this method is probably as good as any; in fact, in the generality of cases, the dimensions of the engines, boilers, etc., are not definitely fixed until a later stage, and the designer is forced to adopt some such method.

Unless great care is taken in selecting a suitable weight per I. H. P., or heating surface, implicit reliance should not be placed on the weights derived in such a manner. Undoubtedly, where the types from which the data has been selected are not very different from that of the proposed machinery, a fair approach to accuracy may be looked for; but even so, when consideration is taken of the number of variables contained in the basis used for estimating, a doubt always remains as to the accuracy of the result. Outside of the effect which mean pressures or the number of revolutions have upon the weight per I. H. P., other disturbing elements have to be taken into account; for example, machinery developing

Formulæ for Estimating Weights of Machinery.

ENGINE-ROOM WEIGHTS.

D = sum of the squares of diameter (in inches) of each cylinder directly connected to cranks.
d = sum of the squares of diameter (in inches) of the upper cylinders of tandem engines.
L = length of stroke (in feet).
n = number of sets of engines.

Screw propeller engines for war vessels:

Launches, pinnaces, torpedo-boats, destroyers, and torpedo gunboats. — Wt. in tons = $.25n\sqrt{DL}$

Battleships, 1st, 2d, 3d class cruisers, gunboats, and commerce destroyers. — Horizontal engines..... Wt. in tons = $.04n[(DL)^{\frac{2}{3}} + 375]$; Vertical engines..... Wt. in tons + $.052n(DL)^{\frac{2}{3}}$

Screw propeller engines for mercantile vessels:

Launches and other small boats..... Wt. in tons = $.27n\sqrt{DL}$

Steamers of all classes, including yachts..... Wt. in tons = $.018n[(DL)^{\frac{7}{8}} + 390]$

Side-wheel engines for mercantile vessels:

Oscillating surface condensing..... Wt. in tons = $.4n\sqrt{DL}$

Diagonal surface condensing..... Wt. in tons = $.35n\sqrt{DL}$

NOTE.—In estimating weight of tandem engines ($DL + \frac{d}{2}$) should be substituted for (DL) in above formulæ.

*From a paper read before the Society of Naval Architects and Marine Engineers, at the Fifth General Meeting.

3,000 I. H. P. may be installed in a vessel 250 ft. long engaged in a short-run service, and a similar set of machinery, developing likewise 3,000 I. H. P., may be fitted in a vessel 400 ft. long engaged in trans-ocean trade. In the latter case, apart from minor differences in the smaller details of the machinery, the increase in length of shafting, and accompanying increase in the num-

SHAFTING, ETC.

Screw propeller shafting:

$D^2 L$ = sum of [diameter^2 (inches) × length (feet)] of crank + thrust + line + propeller shafts.
$d^2 L$ = sum of [diameter^2 of hole (inches) through shaft × length (feet)] of shafting.

Solid shafting ..... Wt. in tons = $.0026\ D^2 L$.
Hollow shafting ..... Wt. in tons = $.0026\ D^2 L - .0012\ d^2 L$.

Paddle engine shafting:

D^2 = mean diameter^2 of crank and paddle shafts (inches).
d^2 = diameter^2 of hole through shafts (inches).
L = beam of vessel + length of one float (feet).

Solid shafting ..... Wt. in tons = $.003\ D^2 L$.
Hollow shafting ..... Wt. in tons = $.003\ D^2 L - .0012\ d^2 L$.

SCREW PROPELLERS.

D = diameter of propeller (feet).
S = surface of propeller (sq. feet).
n = number of propellers.

Steel or bronze, with detachable blades:

	3-bladed.	4-bladed.
When value of $D\sqrt{S}$ is below 50 ..... Wt. in tons =	$.031n\ D\sqrt{S}$	$.028n\ D\sqrt{S}$.
When value of $D\sqrt{S}$ is above 50 ..... Wt. in tons =	$.11n\ (D\sqrt{S} - 36.3)$	$.1n\ (D\sqrt{S} - 40)$.

Cast-iron propellers 20% greater weight than above.
Steel or bronze solid propellers 25% less weight than above.
Cast-iron solid propellers 10% less weight than above.

PADDLE WHEELS.

D = diameter of wheel to axis of floats (feet).
L = length of float (feet).
P = indicated horse-power.
N = number of floats on one wheel.

$C = DLP \div 100N$.

Feathering floats:

When value of C is below 75 ..... Wt. in tons of 2 wheels = $.18C$.
When value of C is above 75 ..... Wt. in tons of 2 wheels = $.06C + 8.5$.

NOTE.—Wt. obtained includes gear for feathering floats.

Radial floats:

When value of C is below 75 ..... Wt. in tons of 2 wheels = $.17C$.
When value of C is above 75 ..... Wt. in tons of 2 wheels = $.054C + 8.5$.

BOILER ROOM WEIGHTS.

D = mean diameter of Scotch and Navy (low cylindrical) types, and of the barrel of locomotive boilers (feet).
L = length, over end plates, of all types (feet).
HS = total heating surface of one boiler.
TS = tube heating surface of one boiler.
N = number of boilers of each type.
d = diameter of tubes (inches).
l = length of tubes (feet).
f = mean diameter of furnaces.
n = number of furnaces in one boiler.
$\pi = 3.14$.

$$A = \frac{HS \times d}{12\ \pi} + nf^2 l,\quad B = \frac{HS \times d}{12\ \pi} + nf^2 (L - l),\quad C = \frac{TS \times d}{12\ \pi}$$

MAIN BOILERS, ETC.*

Scotch boilers:

Single ended ..... Wt. in tons = $.0085N\ [D^2 (L + 2) + HS] + 10N$.
Double ended ..... Wt. in tons = $.0093N\ [D^2 (L + 2) + HS] + 5N$.

Navy (low cylindrical) boilers:

Single ended ..... Wt. in tons = $.0085N\ [D^2 (L + 2) + HS] + 5N$.
Double ended ..... Wt. in tons = $.0085N\ [D^2 (L + 2) + HS]$.

Locomotive Boilers ..... Wt. in tons = $.011N\ [D^2 (L + 2) + HS] - 5N$.

WATER IN MAIN BOILERS.

Scotch boilers:

8 inches above top row of tubes ..... Wt. in tons = $.0117N\ (D^2 L - A)$.

Navy boilers:

6 inches above top row of tubes ..... Wt. in tons = $.0099N\ (D^2 L - B)$.

Locomotive boilers:

6 inches above furnace crown ..... Wt. in tons = $KN\ (D^2 L - C - 125)$.

*The weight of main boilers as given by formulæ includes the weight of plain tubes; where Serve tubes are used an increase determined as follows: $\frac{HS \times 3}{2240}$ = tons increase, should be added to totals.

Values of K in formula for weight of water in *locomotive boilers:*

Boilers with dry bottom and one furnace K = .028.
Boilers with dry bottom and two furnace K = .030.
Boilers with wet bottom and one furnace K = .032.
Boilers with wet bottom and two furnace K = .034.

NOTE.—Tons per inch at above levels of water = approximately $.0021\ DL$.

AUXILIARY BOILERS AND WATER.

Auxiliary boiler and water (horizontal and vertical types) ..... Wt. in tons = $.031ND^2 L$.

ber of journals, etc., probably a larger propeller, loftier funnels and uptakes, have a certain effect on the weight per I. H. P., and it is very doubtful whether, in selecting a coefficient of weight for use in a new design, due allowance is always made for these disturbing elements. It is good practice, in both the hull and engine departments, to make a second and final estimate of weights as soon as possible after the dimensions have been finally decided upon and before the actual work in the shops is commenced. As in the first approximation, each designer has his own method of making the final or check estimate, some preferring to make a direct estimate, computing the weight of each part of the structure separately. This method is open to several objections, chief among which is the time and labor involved and the general unreliability of the result, this last objection arising from the observed fact that no matter how experienced the computer may be, or how familiar he may be with all structural details, the chances are against him of his covering all the ground in the small and varied minutiæ of detail fittings, etc., the tendency being strongly in the direction of underestimating.

The preferable method is to take the recorded detail weights of machinery already constructed and distribute them under several heads or subdivisions, the total of each subdivision to be gauged or measured by that dimension or other salient feature of the structure which exercises a controlling influence on the detail weights forming each particular subdivision. By some such system full advantage is taken of past experiences, and the small details are well taken care of under the different heads, producing a more reliable result with less expenditure of time and labor than by the direct method.

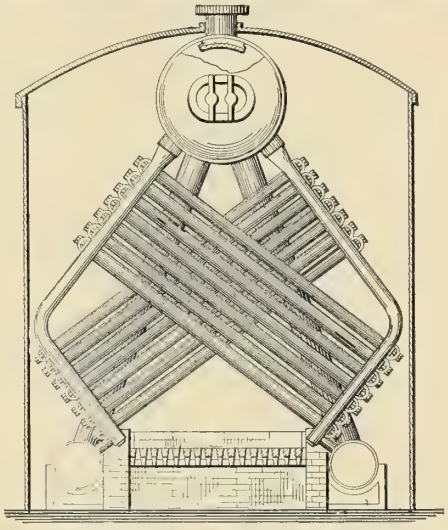
Two important war vessels for a foreign government were launched last month from American yards. The Japanese cruiser Kasagi went into the water at Cramp's yard January 20, and two days later the cruiser Chitose, for the Japanese Navy also, was launched at the Union Iron Works in San Francisco. These vessels are very similar in design, and are rated as second-class protected cruisers. They are nearly 400 ft. long and about 4,800 tons displacement. Both vessels will have high speed and will be supplied with heavy batteries of rapid fire guns. The importance of these contracts is apparent when it is recollected that they were secured in open competition with the world's shipyards.

The White Star liner Britannic recently completed her five hundredth voyage across the Atlantic. She is an iron single screw vessel of about 5,000 tons built in 1874. During this period she has steamed 1,500,000 miles, and burned 513,000 tons of coal. She is still fitted with the original machinery.

IMPROVED APPARATUS.

Carpenter Marine Water-Tube Boiler.

In this boiler the headers are of peculiar construction. The upper ends, where connection is made with the drum, are round in section, but where the tubes connect the section is a parallelogram with round covers. In one side of this tubular header the generating tubes are entered and expanded, and in the opposite side there is a hand hole with removable cover to permit of easy cleaning or renewal. In the marine type the generating tubes run diagonally across the furnace chamber in two oppositely inclined nests.



CARPENTER WATER-TUBE BOILER.

The headers are bent at an obtuse angle so that the tubes connect the upper and lower ends of opposite headers, and there is sufficient room for grate space between. The down pipes are of large bore and connect with two horizontal pipes on a level with the fire bars. It will be noticed these down pipes are carried inside the casing and are exposed to the action of the gases. This boiler is the invention of Prof. R. C. Carpenter of Cornell University, who is also the patentee.

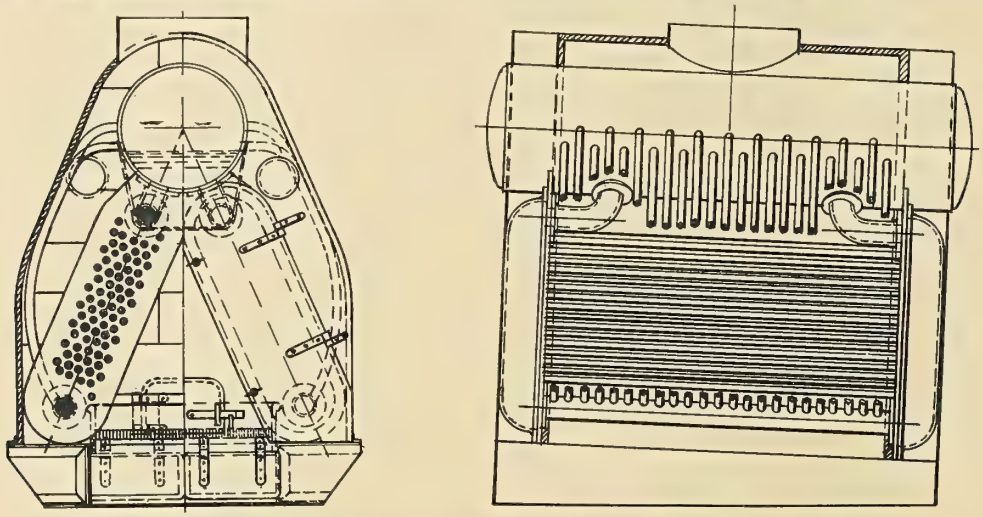
Lumgair Water-Tube Boiler.

A new form of water-tube boiler patented by David Lumgair is shown in the engravings on the next page. It consists of a combination of straight horizontal tubes and vertical bent tubes. The former connect the upright headers, placed A shaped over the grate. At the bottom the headers are connected by large horizontal pipes, and at the tops connections are made with the drum by nozzles. The vertical down pipes connect the drum with the large pipes connecting the lower ends of the headers. The grate is placed in the center, the gases passing between the tubes on each side and over the drum to the stack. There are no bolts or nuts exposed to the fire. The heads are fitted with doors to give access to the interior to the tubes, for ready examination or cleaning. A baffle plate is fixed

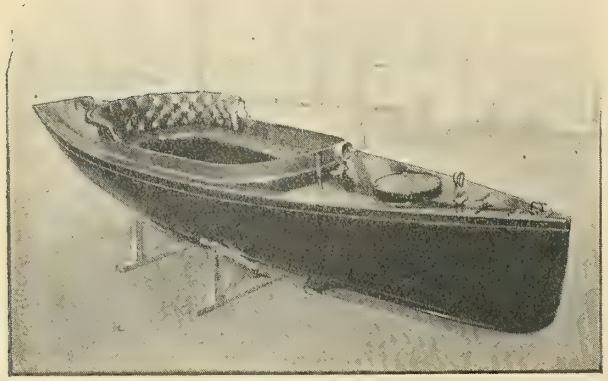
over the tubes and carried up on each side of the drum. David Lumgair, of West Bay City, Mich., is the inventor and patentee.

Electric Gig for Yacht Equipment.

The engraving shows an electric gig recently shipped by the Electric Launch Co. of New York to the Austrian Baron Rothschild at Trieste. This boat is to form part of the equipment of the Baron Rothschild's palatial steam yacht Veglia. It is one of the most finely finished boats of this type ever constructed. The dimensions are: Length over all, 25 ft.; beam, 6. ft.; depth, 3 ft., and length between hoisting shackles, 19 ft. 2 in. There is seating space for fifteen persons and it will be noticed that this is not encumbered with any apparatus or propelling machinery. The motive power, which consists of a set of storage batteries supplying current to a motor attached to the screw shaft, is out of sight. The motor is placed under the grating amidships and the secondary batteries under the seats. The regulation of power and steering is affected by one man, who, by moving suitable levers, can go ahead or astern or vary the speed of the motor. There is, of course, an agreeable absence of noise, heat, or odors during the running of the boat. On trial a regular speed of 6.84 miles was attained. The batteries will be charged from the electric light plant on the owner's yacht, which furnishes light for 400 lamps. When charged they will last for a four hour run. The company, which has its works at Morris Heights, is now at work on a similar, though larger, boat for the Czar of Russia.



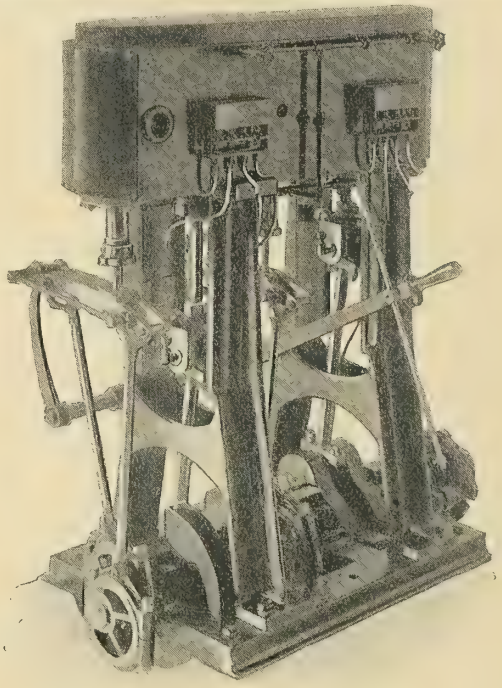
SECTIONAL SKETCHES OF LUMGAIR WATER-TUBE MARINE BOILER.



ELECTRIC GIG FOR BARON ROTHSCHILD.

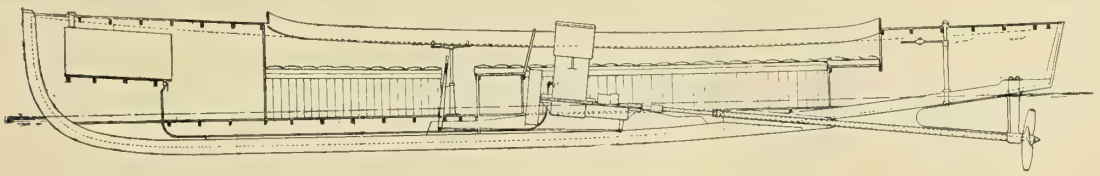
Twiss Vertical Marine Engine.

A standard type of engine built in various sizes, both compound and triple, is shown in the engraving of the Twiss marine engine. The design is simple, the material used is good, and as the wearing surfaces are large the engine is a



TWISS VERTICAL MARINE ENGINE.

successful machine. The crossheads work in slides which are bored out when the cylinders are in place on the columns, so that a high degree of accuracy is secured. Piston valves are used with Stephenson adjustable link motion. A feature of the design is the method of securing the reversing lever which is held to a guide rod by a binding screw and hand wheel. The cylinders are lagged in sheet iron, the tops being made to slip off readily, allowing ready access to the covers. The engine is built by Nelson W. Twiss, New Haven, Conn.



LONGITUDINAL SECTION OF KING MOTOR BOAT.

Improved Type of Motor Boat.

The ordinary motor boat is frequently of cumbrous build, clumsy and wasteful of power, a row boat in fact, with an engine in the stern. The illustrations here show a boat built by the Charles B. King Co. upon the lines which govern the construction of modern, small, high-speed boats. The sectional sketch shows that the dead wood is entirely cut away and is replaced by the rudder, which is forward of the wheel. The position of the rudder makes it little liable to damage, and at the same time the maneuvering powers of the boat are not impaired. The 33 ft. boat of this type, fitted with an engine rated at 6 H. P., is guaranteed by the builders to attain a speed of 10 miles an hour, the control of the boat being in the hands of one man. The design of engine built by the company is seen in the engraving on this page. It is of the two cylinder type, an impulse being given at every other turn in each cylinder. Reversing is carried out in the gear attached to the engine, so that the use of a propeller with reversible blades is avoided. The cranks work in an enclosed chamber, which is partially fitted with oil so that the main bearings and cylinder are lubricated automatically. Starting is effected by withdrawing the relief rod and turning the fly wheel, two revolutions being usually sufficient. The relief rod is then pushed in and the engine is at work. Electric igniters of carefully designed pattern are used. Gasolene is used in the motor. The engine, rated at 6 H. P., weighs 700 pounds. Additional particulars regarding these motors and boats, and a trial boat now in operation on the Detroit river, can be had on application to the builders, the Charles B. King Co., Detroit, Mich.

KING MOTOR BOAT AND GASOLENE MARINE ENGINE.

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WITHIN a comparatively short time vast progress has been made by naval architects and engineers in the construction of extremely high speed vessels. It is to strictly naval, as distinguished from mercantile, needs that this progress is due in greatest measure. The evolution of the torpedo boat from a fast launch to the present seagoing destroyer—which is very ably and concisely stated by H. G. Gillmor, U.S.N., in his paper published in our last issue—has called attention to the possibilities in the way of speed more clearly than any other agency. This knowledge and advancement could not have been gained in purely mercantile practice in a very much longer space of time, if at all, for commercial reasons. The rivalry of governments and the exchequers of nations, however, furnished the stimulus and the means by which present conditions have been reached. Latest in the list of extraordinarily high speed vessels is the Mosher launch Ellide, 80 ft. long with engines of 800 horse power, which, on trials in the Hudson river, covered a mile at the rate of 37.89 miles an hour. Ascending the scale in points of size and power, next comes the torpedo-boat destroyer Express, lately launched by Laird Bros., of Birkenhead, which is guaranteed to have a trial speed of 33 knots or about 38 land miles an hour. This boat is 235 ft. long, 400 tons gross register, and is fitted with engines of 10,000 indicated horse power. Going up another step the mail steamer Connaught, which carries the American mails across the Irish Channel, has a sea speed in excess of 23 knots, day-in-and-day-out. She is 380 ft. long and is fitted with twin-screw engines of about 9,000 indicated horse power. At the top in point of combined size and speed is the North German Lloyd liner Kaiser Wilhelm der Grosse 648 ft. long, of 14,000 gross tonnage, and with a speed record of 22.83 knots, for a full twenty-four hours. All these vessels are fitted with reciprocating engines, with boilers, in the two smaller of the water tube type, and in the two larger, of the cylindrical return-tube type. There is, of course, the 100 ft. boat Turbinia fitted with Parson's steam turbines of 2,500 horse power; but she must as yet be considered an experiment, whereas the others have been built under contract in the ordinary course of business. There are many war vessels afloat with phenominally high speeds, but it is doubtful in most cases if, with the shifting around of trained crews and the few opportunities afforded for practice in continuous high speed runs, they could repeat their trial performances. It is a popular mistake, however, to imagine what we now consider extreme speeds are easily reached and maintained. Only those who are concerned realize the tremendous care necessary in design and construction and the watchfulness and anxiety occasioned to get the results. Railroad speeds may have been reached, but not railroad ease, and cushioned seats, though common enough in locomotive cabs, are not yet part of the equipment of the high-speed marine engine room.

RECENT severe losses, the falling off of river trade, and increased competition, are given as the reasons for the assignment made by the St. Louis and New Orleans Anchor Line. This was made last month to Archibald Woods, an employe of the company, for the benefit of creditors, the assets including steamboats, barges, stock-in-trade, elevators, landing and other property of the company, valued at $98,600. The necessity for such action is much to be regretted as for many years, since the war time in fact, this line has worthily upheld the traditions of Mississippi river steamboating. Not only in the prosaic records of trade, but in song and story the magnificence of the great floating palaces of the Father-of-Waters has been recorded in many tongues. The skill of their pilots, the audacity of their engineers, the luxury of their equipment and service are of world-wide renown. It was in

the sixties that the Anchor Line was formed by a consolidation of short lines touching at various points between St. Louis and New Orleans. A policy of progress was at once commenced, all the old boats being sold or broken up and replaced by finer steamers. Traffic on this route was practically uncontested until the year 1880 when a rival company was organized to operate a tow barge line for handling freight. The railroad building craze which caused the construction of parallel railroad lines also cut into the trade of the company, especially for fast through business. It was during the past two years, however, that the most disheartening and disastrous losses occurred. The cyclone of May 27, 1896, wrecked three of the company's finest steamers, the Arkansas City, City of Cairo, and the City of Monroe, making a loss of about $150,000. In the month of August, following, the steamer City of Hickman, a grand river boat costing $100,000, struck a snag and was lost. Ill luck followed the company closely last year. In the fall the steamers Belle Memphis and Mary Morton were lost by striking snags and $40,000 was written off, and November 18 the new and palatial steamer Bluff City burned to the water's edge, adding $75,000 to the already large total of losses.

UNOFFICIAL figures of British shipbuilding returns for 1897, which have appeared in various foreign marine publications since the close of the past year, show a falling off from the total for 1896. The various authorities, of course, do not agree exactly as to the totals, but an average of the amounts given show a grand total for all private yards of 1,100,000 tons, and this is probably not far from the exact figures. The decline is very generally mourned by the British papers and is unanimously attributed to the great engineers' strike, which prevented the completion of many vessels on the stocks and had also the effect of sending orders to the continent of Europe which would otherwise have been placed in British yards. The falling off is estimated by some of the authorities to be as high as 250,000 tons, but how this total is made up is not apparent, when a comparison is made with the figures for 1896 given out some time ago by Lloyd's Register. These gave a total for 1896 of 1,121,505 tons, which would show a decrease for 1897 of only 20,000 tons in round numbers. An examination of the figures now given for 1897 shows that the relative positions of the leading builders are not much changed from the preceding year. The firm of Harland and Wolff, of Ireland, again heads the list with a total of 84,240 tons. Next comes the English east coast yard of C. S. Swan and Hunter with 48,570 tons and fourth in the list the top figures for a Scotch yard are reached with 42,913 tons for Russell and Co., of Port Glasgow. The total for Harland and Wolff was made up last year as before of large vessels exclusively, ranging from the White Star freight steamer Cymric of 12,340 tons, for the New York-Liverpool trade, to the smallest steamer of 4,582 tons.

THE members of the Marine Engineers' Beneficial Association held their annual convention at Washington, D. C., January 18 to 21. About forty delegates were present, representing local associations all over the country, both on the coasts and lakes, places as widely apart as San Francisco being represented by Vice-President Jones, Duluth by A. McGillivray, Galveston by John A. Cotter, and Pensacola by James L. Sweeney. The meeting was presided over by President George H. Uhler, who has ably served the Association for many years and who was unanimously elected for the ensuing year. Secretary Thomas F. Dowd, of Chicago, was also in attendance. The sessions were private. Business to be transacted included the discussion of reports, appointment of committees, and the discussion of various matters affecting the welfare of the members of the Association, and in fact all who occupy positions as engineers of vessels. A matter of importance which received much attention was the proposition of some of the members to establish a paper to be devoted to the interests of the Association. A representative of Marine Engineering was requested to submit a proposition to a committee of the whole. This was debated and finally referred to the Committee on Publication. The convention received the captains and pilots on Thursday evening, January 20, at 6 o'clock, and also the Board of Supervising Inspectors, which was holding sessions at this time. This was in accord with a long established custom, as the relations between these bodies are very harmonious. The Marine Engineers' Beneficial Association is purely fraternal and beneficial, rendering brotherly assistance among its members, and paying death and disability benefits.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.

The annual meeting of the American Society of Naval Engineers was held in Washington, D. C., January 7 and 8.

This year, for the first time, the society held meetings for the reading of papers and the general discussion of naval engineering topics. On previous occasions the members have met together simply to elect officers, and the society has published papers in its excellent journal which appears quarterly.

First Day, Friday, January 7.

On the opening day the meeting was called to order in the hall of the Columbian University, Friday afternoon, January 7. In the absence of the President of the Society, Chief Engineer Smith, Chief Engineer H. Webster was called upon to preside. Mr. Webster welcomed the visiting members, and read a letter from Engineer in Chief George W. Melville, U. S. N., in which he regretted that he was unable to be present at the meetings, he having been called to the Capitol on departmental business. The report of the council was then read by the secretary, Past Assistant Engineer F. C. Beig; it was a brief statement relating to the affairs of the society, and informed the members that a button or badge for the society had been decided upon, a roseate of gold and red. He informed the members that the council had, after carefully going over the papers submitted, presented the yearly medal to Passed Assistant Engineer W. W. White, for his paper designated "Facts, Not Fiction," its subject being "Steam Consumption of the Main and Auxiliary Machinery of the U. S. S. Minneapolis."

After the reading of the report, the presiding officer congratulated Mr. White upon his very admirable treatise, and presented him with the society medal.

Mr. White, who was very warmly welcomed, then proceeded to read his paper, which we shall publish in an early issue. The paper called forth quite an animated discussion. F. W. Wheeler, of New York, discussed the paper at length, and pointed out that some of the auxiliaries were working under disadvantages. He very strongly urged the advisability of using the exhaust steam from all the auxiliaries for feed water heating, and stated that considerable saving would be effected in this way. He also thought that the time had come when more attention should be paid to the design of the auxiliaries themselves, and urged compounding.

It was afterwards pointed out by a number of the officers of the Navy that it was almost impossible to fit feed water heaters in the naval vessels for lack of space.

The second paper was upon "American Steam Yachts," by Irving Cox, of New York. Mr. Cox deplored the fact that so many Americans went abroad for their vessels instead of having them built at home; he did not think that American yachtsmen treated the designers at all fairly. They asked for a great deal more speed in a given sized boat than the English builders would give them, and then were surprised that such boats cost more money. The paper contains some interesting figures with regard to the maintenance of a first-class yacht, the cost for a cruising yacht being from $3,600 to $4,000 per month.

Two papers were then read by the secretary, the authors not being present. These were: "Tests of the Niclausse Safety Water-Tube Boiler," by J. M. Whitham, of Philadelphia, and "Water-Tube Boilers," by Darwin Almy, of Providence, R. I. These papers were discussed together, and called forth a good deal of remark. The discussion was taken part in by Passed Assistant Engineer Walter M. McFarland, who has written much on this subject. He pointed out the fact that it was necessary that a great deal more attention should be paid to the details of construction, and also stated that because in the Navy they had to use very high pressures, the water-tube boiler had become a necessity.

Charles Ward, of Charleston, spoke of the great development that had taken place in water-tube boilers in the last few years; he advocated the building of the boilers in such a way that they could be easily inspected and repaired. He strongly deprecated the use of boilers with tubes that were nearly horizontal.

John Platt, of New York, spoke at length on the general subject. He advocated the building of water-tube boilers with "boiler making" details instead of those of the steam engine builder, as is done at present by many builders. He pointed out that a marine water-tube boiler, to be good, should be capable of the very highest degree of forcing. That when so forced the economy should not run down rapidly and the uptake temperature should be low. That boilers were in service in which this was possible, and if these were compared with the Scotch boiler, then the economy would not be on the side of the old type of boiler.

Jarvis B. Edson, of New York, spoke as a yacht owner, and pointed out that his fellow yachtsmen were on the lookout for an economical boiler which would not have to be laid up for repairs the greater part of the time.

A number of the other members took part in the discussion, the general tenor of their remarks being that the water-tube boiler must now be looked on as the one for use in the new naval vessels.

The next paper was read in person by David P. Jones, on the subject of "Boiler Testing with Various Fuels." This paper is of great value, as it gives the result of the burning of many different kinds of coal. It should act as a warning to the boiler man not to make a guarantee on evaporation without taking the kind of coal into account. The paper called forth a good deal of general discussion.

In the evening the members of the society held a business meeting in the rooms of the Chief of the Bureau of Steam Engineering in the Navy Department. The secretary-treasurer's report showed a fair increase in membership for the year, and also that the financial condition of the society was very good. Officers for the ensuing year were then elected, as follows: President, Chief Engineer Harry Webster; Secretary-Treasurer, Passed Assistant Engineer W. M. McFarland; Members of Council, Chief Engineer F. W. Baird, Passed Assistant Engineer W. W. White and Passed Assistant Engineer E. Theiss.

Second Day, Saturday, January 8.

On Saturday morning at 10 o'clock the members met at the office of Chief Engineer Baird, in the State Army and Navy Building. A photograph of the group was first taken, and then the members visited the Congressional Library, and from there they went on to the Washington Navy Yard and inspected the gun shops. At 2 o'clock in the afternoon the meeting was again called to order in the Columbian University Hall. The first business was the discussion of Mr. Jones' paper on "Boiler Testing;" after this, a paper on "Speed of Construction," a vital factor in naval strength, was read by Frank B. King, of Washington. This paper was a very prolonged letter, and advocated very radical changes in the methods of the construction of ships. The author advocated the adoption of bridge building methods in ship building, and pointed out that if care was taken to so design vessels that reproducing methods could be used, then the time of production would be cut down very materially. This was followed by a paper by Col. E. D. Meier, of St. Louis, on the Diesel Motor." The speaker seemed to think that in the very near future this motor would be used in very large sizes in marine work. It is an improved oil engine, invented by a German engineer. From the results of tests given, the engine is undoubtedly a good one, and in-

teresting developments may be looked for in the near future. It is claimed that a higher efficiency has been obtained with it than with any other heat engine, whether it be steam, gas or oil.

The last paper read was on "Oil Fuel Trials on the Lifeboat Queen," by John Platt. This paper describes in full the hydraulic lifeboat which was illustrated and described in our January issue, and further gives the result of oil fuel trials made on the Thornycroft boilers of the boat. After the discussion of this paper the following papers were read by title:

"The Submarine Boat Plunger," by J. Alvah Scott, of Baltimore.

"Entropy and Temperature Entropy Diagrams," by Prof. W. F. Durand, of Ithaca, N. Y.

"The Status of Boards on Changes as Usually Constituted Under the Contracts for the Construction of Our New Navy," by W. W. Varney, of Baltimore.

"Propulsive Power," by James N. Warrington, of Chicago.

After the usual vote of thanks, a very successful meeting was brought to a close. For a first venture the meetings were undoubtedly a success. Another year, with more time at the disposal of the officers of the society, great things may be expected and a very much larger attendance.

Though this was the ending up of the business of the convention, the social side included the First Annual Banquet of the society, which took place on Saturday evening at the Maison Rauscher. A Washington paper reports that "the dinner in itself was one of the most elaborate and elegant ever given at Rauscher's, while the informal speeches of the evening were bright and appropriate." John C. Kafer, of New York, acted as toast master. He made a very neat speech of welcome, in his usual affable manner. Informal speeches were made by Jarvis B. Edson, Col. E. D. Meier, Passed Assistant Engineer F. C. Bieg, Passed Assistant Engineer W. M. McFarland, Chief Engineer Baird, Chief Engineer Robie and others.

Fatal Explosion on Ohio River Steamer.

An explosion on the Ohio river steamboat Percy Kelsey killed five and injured eight of the crew, besides wrecking the boat. She was towing nine coal barges to Cincinnati, and when just below Glenfield station on the Pittsburg, Fort Wayne and Chicago Railway, shortly before noon of January 8, the explosion occurred without the least warning. Robert J. Davis, the chief engineer, who was on duty in the engine room, and who was among those not injured, said afterward that there was plenty of water in the boilers at the time and all the apparatus was working effectively. He had just made an inspection of the machinery in readiness to turn over to the assistant engineer, who was about to come on watch. The boat was completely wrecked, as will be seen in the reproduction of the photograph, which was taken for the Pittsburg Despatch soon after the explosion. A terrific report accompanied the explosion and many of the windows in the houses in Glenfield were shattered, which was also bombarded by portions of the machinery and wreckage. One section of the boiler 10 ft. long was carried some distance from the river bank before it fell. Many of the crew were frightfully torn and disfigured, and several of those not killed outright were not expected to recover.

The boat, which was built in Pittsburg in 1882 by W. H. Brown's Sons, was 148 ft. long, 31 ft. beam and 4 ft. 8 in. deep in the hold. Her carrying capacity was 245 tons. She had four boilers and the usual form of river stern-wheel engines. Three of the boilers had been in the boat since she was built and the fourth had been put in in 1886. She had been regularly inspected by the Government inspectors, the last inspection having been made in May last. She was valued at $40,000, but is said to have carried no insurance. The barges which the steamboat was towing were not damaged.

CORRESPONDENCE.

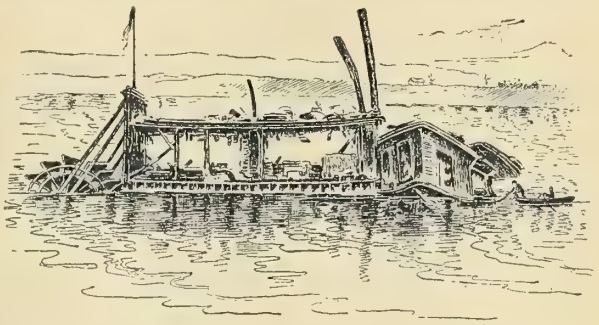
[Communications on matters of interest to marine engineers, for insertion in the correspondence department, are solicited. These, wherever possible, should be supplemented by rough sketches or drawings, which will be reproduced if necessary to illustrate the subject, without cost to the writer.

Full names and addresses should be given, but publication of these will be withheld where requested.

We do not assume responsibility for the opinions expressed by correspondents.]

Regarding the Position of Screw Propellers.

In reply to your correspondent who asks regarding the arrangement of twin screw propeller shafts (in the January issue), it may be first pointed out that the case most commonly found is that in which the shafts are farther apart at the propellers than at the engines. This is due, however, not to considerations relating to the performance of the propellers, but rather to considerations involving various questions of structural arrangement in connection with the form of the after body of the ship. In the usual case the disk circles of the propellers do not overlap, but are separated by 1 or 2 ft. or more, depending on circumstances. The distance between the shafts at the propellers is thus approximately fixed by the diameter of the latter. Passing forward to the engines it is not usually found feasible or desirable, having due regard to a compact arrangement of machinery, to place the shafts as far apart as at the stern. Especially in narrow vessels or those with considerable rise of floor, there would be insufficient room outboard for the necessary arrangement of the machinery, including auxiliaries, pipes, outboard valves, etc., while an unnecessary amount of room would be provided between the two engines. The latter are therefore naturally moved toward the center line, thus giving a divergence to the shafts from forward aft. This has the further advantage of running the shafts through the ship's side at a more favorable angle than if they were parallel to the keel, or converged from forward aft. It is readily seen that with parallel shafts or with a slight convergence, they might, with fine after body, be so nearly parallel to the skin of the ship that the structural disturbance attendant on carrying the shafts through the skin would be much greater than with a slight divergence as in the usual case.



STEAMBOAT PERCY KELSEY AFTER THE EXPLOSION.

We may now turn to the considerations involved in the action of the propellers. The water in closing in behind and under the ship follows to some extent the form of the after body, and hence the streams on either side converge from forward aft. It follows that with shafts parallel to the keel the propellers will work in a stream flowing oblique to the shaft upon which they revolve. It may be shown geometrically that this gives rise to a variation of slip during the revolution of a given blade, more and more pronounced as the obliquity is greater. The result of this variation of slip is an irregularity in the resistance to the movement of the blade, a consequent tendency to irregularity of motion, and a loss of efficiency due to working over a wide range of slip in-

stead of at a nearly constant value. It is also evident when the shafts diverge from forward aft, as in the usual case, that the obliquity of flow of the stream relative to the propeller will be still greater, and the effects above noted will be still more marked. For smoothness and efficiency of operation, therefore, the propeller shafts would rather be made to converge from forward aft so as to bring them more nearly parallel with the average lines of stream flow. These considerations are therefore directly opposed to those relating to structural arrangement, as above referred to.

Another consideration bearing on the question has relation to manœuvering power. With the shafts parallel it is evident, if one propeller is turned ahead and the other back, that a pronounced turning moment or effort will be produced. If, however, the shafts diverge from forward aft at a considerable angle it may be that their lines of action if continued forward would meet and cross at about the center of resistance to motion. In such case if one engine is turned ahead and the other astern, the ship will simply sidle off crabwise, without definitely turning in either direction. If in an extreme case the lines of action should cross aft of the center of resistance, the turning effect would be the reverse of that in the usual case. It follows that parallelism or a convergence from forward aft would be favorable to a pronounced turning effort, and while this is not usually feasible, care should be had that the divergence from forward aft is not so great as to seriously interfere with the manœuvering power of the screws.

With regard to the angle of drop in a single screw shaft, the same general considerations apply. The inclination is usually due to structural reasons, or to the necessity of getting sufficient immersion for the propeller. It gives rise to a periodic variation in the slip, and tends to produce irregularity of motion and loss of efficiency, though only in small degree with the usual angles. As a further point bearing on both single and twin screw shafts, mention may be made of the loss due to the obliquity of the shaft to the line of motion. The thrust considered as exerted along the line of the shaft is not in the direction of motion, but slightly oblique, and thus introduces a loss, though very slight in all usual cases. A loss of 1 per cent would correspond to about 8 deg. inclination, or a slope of one in seven.

Again, with single screws working on a shaft sloping down from forward aft, the thrust tends to lift the stern somewhat, and thus, as far as it may go, this influence will antagonize the change of trim or squatting of the stern so commonly met with in small boats at relatively high speeds.

It is readily seen from the preceding brief mention of some of the more important considerations entering into this question, that like all others in engineering it is one involving many antagonistic considerations, and that any solution must necessarily be in the nature of a compromise between them.

W. F. Durand.

In Further Discussion of Walschaert Gear.

In regard to my request published in your November issue for a diagram of the Walschaert valve gear, I have noted the reply to the same in your January number, signed C. H. Peabody. His reply, however, does not cover the entire question, as he simply confirms the conclusion that it is impossible to construct a diagram of this gear, or any radial gear, and that the only way to study it is by means of a model, or in other words, by a system of trial and error. His sketch showing the gear as applied to locomotives is essentially the same as that shown for marine use. My idea of a diagram for this gear is one in which the variations of release and compression may be shown in a general way for different degrees of linking in, without any definite sizes being used, also the effects of linking in. H.

The Turbinia and Her Performances.

Seeing the great interest that seems to be aroused by the performance of the "Turbinia," it might prove of interest for your readers to have an unbiased analysis of a professional torpedo-boat designer on the performance of the Turbinia, and more important, on the causes that contributed to the marvelous speed she attained. Having been in charge of the construction of U. S. torpedo boat Ericsson I might use that vessel for comparison and also in some way the performance of Mr. Mosher's "Ellide" as a high-speed boat fitted with reciprocating engines.

Let us assume for the sake of convenience that the Turbinia made 30 knots on the measured mile. Such speed on about 44 tons displacement would require about 2,340 I.H.P., assuming an Admiralty constant of 164 for the formula.

$$\text{I.H.P.} = \frac{V^3 \times D^{\frac{2}{3}}}{C} = 2340$$

which probably will be near the actual power.

We will have to consider the three phases of propulsion and their efficiencies separately and try to find which mainly contributes to the success of the boat:

First Phase: Generation of steam in boiler.

Second Phase: Transformation of steam energy into rotation of shafting and propellers through the engines.

Third Phase: Transmission of motion to hull through action of propellers on water.

Now Mr. Parsons attributes the success of the boat to an improvement in the second phase—substituting turbines for reciprocating engines—while I consider that certain features of the first and third phases are the only real causes for the high speed attained. The turbine engines appear to me as of subordinate importance and comparatively little commercial future for marine propulsion.

The notable feature of the third phase is, applying successfully small propellers revolving at over 2,000 revolutions to marine propulsion, in an arrangement of three propellers on one shaft, and we are indebted to Mr. Parsons for publishing his observations and experiments on cavitation caused by quickly revolving screws.

The most important feature responsible for the success of the boat is the one of the first phase, viz., driving a small boiler at such excessive rates of coal consumption and evaporation, as in the Turbinia, about 2,340 I.H.P. from about 1,100 sq. ft. heating surface and about 42 sq. ft. grate surface, under about 7 in. of air pressure were obtained, something enormous for marine conditions. This means about 56 I.H.P. per sq. ft. of grate and at least 120 lbs of coal per hour per sq. ft. of grate. This consumption has been equaled only in locomotive boilers, formerly used in torpedo boats, but now discarded for water-tube boilers burning a maximum of 50 lbs. of coal per hour per sq. ft. of grate and about 2 in. air pressure, as exemplified in the Ericsson. Such excessive combustion as in the Turbinia is considered by the best authority impractical, except for show purposes, the coal consumption being wasteful and combustion anything but good. Then an allowance of only 1,100 sq. ft, heating surface for double the number of I.H.P. is considered entirely inadequate for transmitting such an amount of heat to the water. The allowance in the Ericsson of nearly 4,700 sq. ft. heating surface and 85 sq. ft. grate surface for 1,800 I.H.P. indicates the experience of different navies, that consider also the question of durability, safety and immunity from break downs. "Turbinia" practice can be only executed in an experimental boat, where all considerations of economy, safety and commercial practicability are sacrificed to the one item of speed. We will have to wait quite a while before we see any conservative navy subject its torpedo boat boilers to such an ordeal of stress, combined with such wasteful expenditure of coal. Especially in batteries

of large sizes boilers under such treatment would be ruined in a short time.

To attain excessively high speed we need no turbines, as Mr. Mosher has proved lately with the Ellide with a trial speed of more than 30 knots and regular reciprocating engines under the advantage of efficient reversibility, lower number of revolutions and more general accessibility, that offset manyfold the advantage of turbines—no reciprocating parts, higher expansion rates and slightly decreased weight.

Summing up, we must say, that our experience of construction of high speed boats has been decidedly enriched by Mr. Parsons' bold experiment. It is to be regretted, however, that the success has not been attributed to the real causes, but rather used for an one-sided advertisement of a special type of engine. The expression that, "the total weight of machinery in torpedo boats on the turbine system will probably not exceed one-third that of ordinary engines of the same power," is decidedly incorrect and only misleading.

THEODORE LUCAS.
Philadelphia.

Shipbuilding in Bath, Maine.

In no shipbuilding center is there more activity at the present time than Bath, Me. A list of vessels now contracted for by the local shipbuilders includes:

Bath Iron Works, two 30 ½ knot torpedo boats, $390,000; one lightship, composite, $75,000; one steel cargo steamship, $190,000; one steam yacht, $450,000; Gardiner Deering, one four masted schooner, $68,000; Arthur Sewell & Co., steel sailing ship, $185,000; N. T. Palmer, one five masted schooner, wood, $80,000; Percy & Small, one four masted schooner, wood $65,000; Kelley, Spear & Co., one ferryboat, wood, $30,000; nine coal barges, wood, $210,000; New England Shipbuilding Co., one wood passenger boat, $20,000; one four masted schooner, $60,000; three wood barges, $70,000; grand total is $1,893 000.

It is expected that the Bath Iron Works will be awarded the contract for the composite practice vessel for the Naval Academy. This will add about $175,000 to the above total and it is rumored that other contracts will be closed in a few days. The three barges building by the New England Shipbuilding Co. are 200 ft. long, 35 ft. beam, 17 ft. deep, with a carrying capacity of about 1,600 tons each. Three of the barges building at the Kelley & Spear yard are for the Staples Coal Co., of Taunton, Mass., and two are for the Black, Sheridan, Wilson Co., of Baltimore. Two of the former have a capacity of 1,500 tons each and are 180 ft. long, 36 ft. beam and 16 ft. deep. The remaining barge for the Staples Coal Co. will have a capacity of 500 tons and will be 133 ft. long, 31 ft. beam and 8 ft. deep. The two barges for the Baltimore Co. have the same dimensions as the New England Co.'s boats. The passenger boat building by the New England Co. will serve as a tender to the Wentworth House, Portsmouth, N. H. She is being built to the order of Frank Jones and is designed by the Bath Iron Works, which concern will build the machinery. She is 93 ft. long over all, 85 ft. water line, 18 ft. 6 in. beam on water, 22 ft. 6 in. extreme beam and 6 ft. draught. She will be fitted with a water-tube boiler. N. T. Palmer's schooner will be the largest schooner in the world and much larger than the Gov. Ames, and the other vessels of the Palmer fleet. The steel ship which is being constructed by Messrs. Arthur Sewell & Co. is very similar to the Dirigo, which was built by this firm three years ago. She is 312 ft. long on the water line, 45 ft. beam, and is designed to carry 4,400 tons dead weight on 22 ft. 6 in. draught, and to stand up without ballast when light in port. The ferryboat building by Kelley, Spear & Co. is for the Maine Central R. R. to replace the old City of Rockland, and to act as a spare boat on the Kennebec river between Bath and Woolich. She is a side wheeler about 130 ft. long. The Bath Iron Works is to build the machinery.

EDUCATIONAL.

THE ART OF MAKING MECHANICAL SKETCHES, FOR MARINE ENGINEERS.—III.

BY PROF. C. W. MACCORD.

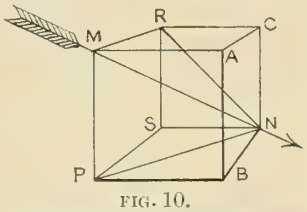


FIG. 10.

When two elevations and a plan are required for the complete representation of an object, these three views are ordinarily disposed in relation to each other as explained in the preceding article in connection with Fig. 5.

But sometimes space can be saved, without at all impairing the clearness of the drawing, by adopting a different arrangement, which is illustrated in Fig. 8. We have here a small bed-plate, or stand, such as might be used for supporting a mechanical model; it consists of a flat plate, stiffened all round by a flange on the lower side, which at each corner is extended downward, thus forming four L-shaped legs; on the top are four small facing-strips with lugs. Sup-

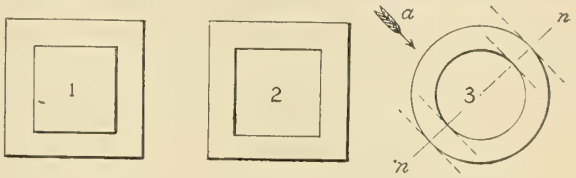


FIG. 9.

pose this bed-plate to be cut lengthwise by a plane *n n*, and the nearer portion to be removed; then the front view A represents the part that is left, thus forming a *sectional elevation*, the divided metal being indicated by hatching, or as it is oftener called, "sectioning," it with fine parallel lines inclined to the outlines. Simple as this subject is, it is apparent that the structure is thus shown much more clearly than it would be by an outside view.

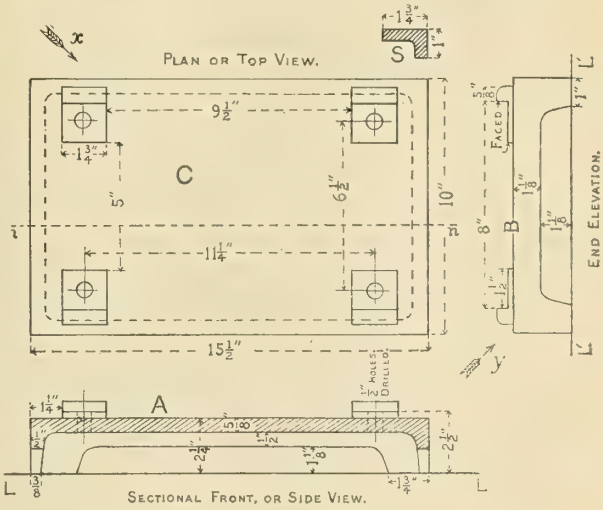


FIG. 8.

Above this is placed the top view C; and so far the arrangement is the same as in Fig. 5. But the end elevation B, instead of being placed at the right of A, is placed at the right of C; by turning the drawing so as to make the base line L' L' horizontal, it will be seen that *C* will have the same relation to B that

it now has to A, and can be studied in connection with it, perhaps even more advantageously than it could be if it had been placed as in Fig. 5. And since the height of the object is small is comparison with its breadth, the whole drawing is made much more compact than it would have been, by this simple expedient, which may also be employed with excellent effect in other cases: thus, for example, had it been required to make a transverse section as well as an end view, then instead of stringing these out side by side, one might be placed at the right of A as in Fig. 5, and the other at the right of C, as here shown.

Another "wrinkle" is illustrated in Fig. 8, by introducing the section S, which is a top view of what would be seen were the L-shaped leg at that corner to be cut by a horizontal plane just above the base-line *L L*, and all above that plane removed. This obviates the necessity of showing this by dotted lines in the top view C, the attempt to do which, as a very little study will make evident, would have made the drawing rather confusing than explanatory, although it might be perfectly correct; it is often unwise to try to show in one view what can be better shown in two. And the addition to the principal views, of such auxiliary representations of certain parts, is frequently of great advantage in making original drawings, while to the one who is making sketches this expedient is invaluable.

Of Shadow Lines.

Lines may be distinguished as thin or thick, fine or coarse, light or heavy, indifferently. It will have been noticed that in this respect the outlines of several of the preceding figures differ among themselves to a marked degree, and no one can have failed to be struck by the effect of *relief* thus produced. Particular attention to this is called in Fig. 9; comparing *1* with *2*, it is perfectly obvious that the former represents one square block lying above another, while the latter represents a similar block with a square hole through it, or at least with a square depression in it; and in like manner, 3 represents a circular disk with a round hole through it. The outlines, then, are not mere diagrams, but represent objects having sensible thickness, which if resting upon a plane surface would cast shadows upon it. The lines which are made heavy in all cases represent the sharp *edges* of surfaces which intercept the light. Thus they not only produce relief, but enable us to distinguish an object which has sharp edges, as a prism or a pyramid, from one which has not, such as cylinder or a cone. It would be impossible here to explain how to determine in all cases what visible lines do cast shadows; but the intelligent reader may be guided to some extent by the consideration that much depends upon the direction in which the light comes. For the sake of uniformity it has been agreed that this shall be as shown in Fig. 10. There the large arrow represents a ray of light, which pierces the transparent cube at the upper left-hand corner *M*, and passing bodily through it, emerges at the lower right-hand corner *N*. From what precedes it will be clear that the projection of this ray on the vertical face *S C* will be *R N*, and the projection on the horizontal face *S B* will be *P N;* since each face is a square both *R N* and *P N* make angles of 45° with *S N*, which is a horizontal line. In this figure then it is apparent that of the three visible faces of the cube, the upper face *M C* and the front face *A P* will be illuminated, while the right-hand face *B C* is not; so that the edges *P B*, *B A*, *A C*, intercepting the light, would cast shadows, and these lines are accordingly made heavier than the other outlines.

Now in Fig. 9, the direction of the light being indicated by the arrow *a*, the lines which cast shadows in the two objects at the left can be determined by mere inspection. As to the one on the right, it is equally obvious that the shadows will be cast by the lower right-hand part of the outer circle, and by the upper left-hand part of the inner one; and the points where these shadows begin and end will be the points of contact of lines parallel to *a* and tangent to the circles; they may be exactly located by drawing *n n* through the center and perpendicular to *a*. At these points the thickness of the shadow line will be no greater than that of the outlines, and will gradually increase, being greatest at a point midway between them.

In the case of any *elevation*, then, the shadows fall toward the lower right-hand corner; but in a plain

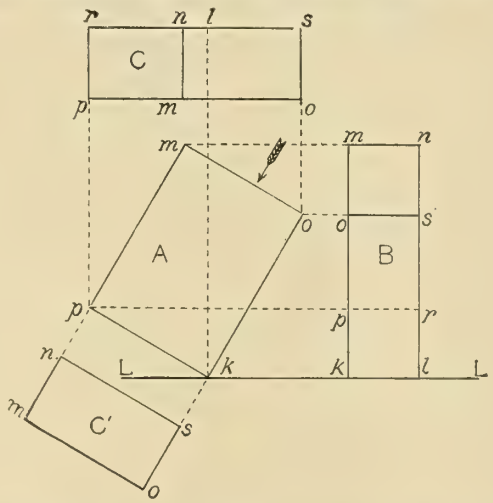


FIG. 11.

view, they would fall toward the upper right-hand corner, were the direction of the light shown in Fig. 10 to be adhered to. But since in studying a plan the observer is supposed to be looking downward, the light if coming from above must come from behind, the actual direction is of less consequence, and therefore may be assumed to pass through the cube in the direction *R B*. This has the effect of causing the shadows to fall toward the lower right-hand corner,

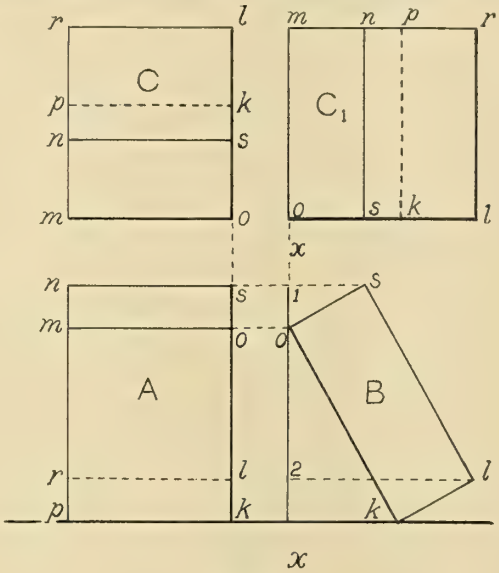


FIG. 12.

and for the sake of uniformity this is, in this country and in England, the accepted practice. This is illustrated in Fig. 8, where the arrow *x* indicates the direction of the light for the plan as well as for the sectional front view A, and would serve also for the elevation B had it been placed at the right of A as in Fig. 5. But since in studying this view the base line

L′ L′ must be horizontal, the light must come in the direction shown by the arrow *y*. Also, it is to be noted that the figures and the writing in this view are so arranged that in order to read them with facility, the drawing must be turned so as to bring the base line into a horizontal position.

Logically, this discussion may seem rather premature, but in spite of the fact that a line which intercepts the light is in reality no thicker than one which does not, it is beyond dispute that the use of shadow lines not only improves a drawing by producing the

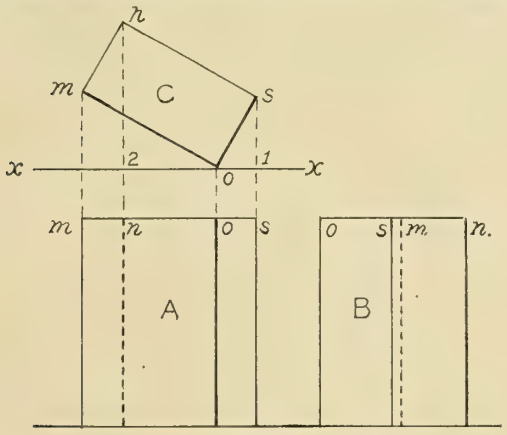


FIG. 13.

effect of relief and solidity, but for that very reason it facilitates the *reading* of the drawing and makes it more intelligible. And these lines are just as effective in the rudest sketch as in the most elaborate drawing: some idea of their meaning and of their proper location should therefore be acquired at an early stage.

Representation of Objects in Oblique Positions.

As the first step in this direction, the same simple block shown in Fig. 5 is reproduced in Fig. 11; not

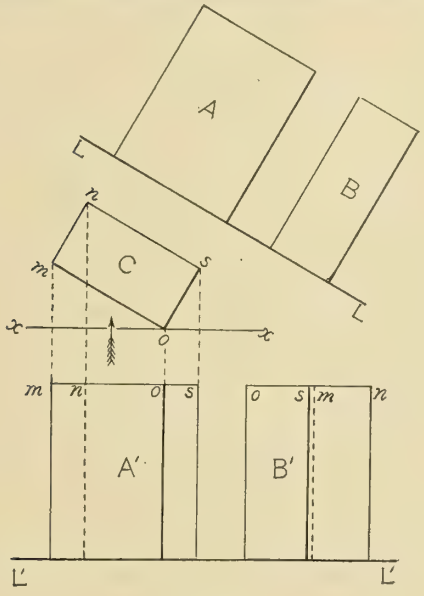


FIG. 14.

in the vertical position, but inclined to the right in the front view A, having been turned upon its right-hand lower edge, represented by *k*, as upon a hinge. The points *k*, *p*, etc., here represent, just as they did in the original position, right lines perpendicular to the paper, and of a length equal to the thickness of the block. Therefore in the view B they will be seen in their true length as the horizontal lines *m n*, *o s*, etc., their heights, or distances above L L, being the same as those of their extremities *m*, *o*, etc., in the front view. And in the top view they will also appear in their true length, each being perpendicularly above its corresponding representation in the view A. By this rotation, then, the front view is not changed, either in form or in dimensions; and the distances from front to rear, as seen in the views B and C, are likewise unaffected. The heights of various points are changed, but they are still alike in A and B; the distances from right to left in A and C are changed, but they are yet the same in both those views.

There is shown in this figure an additional view C′, which represents the upper face of the prism, as it would be seen by looking in the direction of the arrow; which appears therefore in its true size and form. This arrangement is often of great utility both in drawings and in sketches.

Next, in Fig. 12 the same object is represented as tilted over toward the observer, turning about the edge *p k*, which in the view B appears as the point *k*. Neither the form nor the dimensions of this view are changed, nor are the *breadths* in the other two views affected by this rotation. The front view therefore shows the lines *n s*, *m o*, etc., of their true length, and at heights the same as those of *s*, *o*, etc., in the view B. If the top view C be placed as heretofore, over the front view, these lines will also be seen in their true length, and their distances from each other are obtained from view B, thus: Draw a vertical plane *x x* through the corner *o;* this contains the nearer edge *m o*, and in C the distances *o s*, *o l*, etc., are equal to *1 s*, *2 l*, etc., being the distance of *s*, *l*, etc., from *x x*. But the top view may be placed over the side view, as shown in C_1; in which case the lines *o m*, *s n*, are simply projected up from *o s*, etc., in the view B, their lengths being made the same as in view A. Of these two positions of the top view, either may be used at pleasure or according to con-

Third, placing the prism upright again, in Fig. 13, let it be turned around one of its vertical edges. The top view C is then unchanged in form and dimensions, and evidently the height remains unaffected. The positions of the vertical edges in view A will clearly be directly under the points *o*, *s*, etc., in the top view. Drawing a vertical plane *x x* through the nearer edge *o*, parallel to the paper in the front view, the side view B is constructed by making the distances *o s*, *o n*, etc., equal to *1 s*, *2 n*, etc., in view C, being the reverse of the process before described in connection with Fig. 12.

The same result may be reached in another way, which is frequently of great convenience, and is illustrated in Fig. 14. Here A. B., and C represent the prism in its original position. The top view is placed below instead of above the front view, which again is purely optional, one position being as correct as the other. To use a geographical illustration, A is a view of C as seen from the south, and B a view as seen from the east. Now without changing the position of C, let us make a view of it as seen from the southeast—or nearly so—as shown by the arrow. The horizontal plane will then appear as L′ L′, perpendicular to the arrow, and the new front view A′ is constructed by projecting *m*, *o*, etc., perpendicularly upon this new base line. The plane *x x* is drawn through *o*, as before, and the new side view B′ is constructed by means of it precisely as B was in Fig. 13.

It has already been remarked, that in making either a sketch or a finished drawing, the simplest position in which the object can be placed is always the best. But the structure may be of such a nature that when the simplest postion for the whole has been selected, some parts of it may be inclined, and necessarily must be *foreshortened* in the representation. Some knowledge of the methods of dealing with such cases is, therefore, essential, and is preferably to be acquired as soon as possible.

ENGINEERS' DICTIONARY.—II.

Air Gauge or *Draft Gauge.*—An instrument for measuring the excess of air pressure in the ash-pits or fire-room over atmospheric pressure, or for measuring the defect of pressure in the uptake or smoke-stack base relative to the same standard. The simplest form consists of a bent tube containing water in the lower part. One of the open ends is connected with the space within which the pressure is desired, and the other is left open to the air. If a difference of pressure exists, the two legs will not stand at the same height. One will rise and the other fall, the movement being toward the lesser pressure. The difference in height will then represent the difference in pressure, and is usually read in inches. It is for this reason that draft pressures are usually expressel in inches of water. With ordinary stack draft the pressure is usually from 1-4 in. to 1-2 in., or 3-4 in., with assisted mechanical draft from 1-2 in. to 1 in., with forced draft on large ships from 1 in. to 2 in., while on torpedo boats and fast yachts the pressure may rise to 5 in., or 6 in., or more.

Alarm Valve or *Sentinel Valve.*—A valve placed on a boiler for the purpose of indicating the existence of low water. There are many varieties of such devices. In some the fall of the water below a certain point uncovers the open end of a pipe, allowing the water with which it was previously filled to flow out. This pipe extends upward outside the boiler, and is closed at the outer end with a plug of fusible metal, beyond which may be placed a small steam whistle, if desired. So long as this pipe is filled with water, its temperature at the plug will be lower than the melting point of the latter, but on the entrance of steam the plug melts and the escaping jet furnishes the warning desired. In other cases the fall of the water carries with it a float, connected by lever arms and rock shaft to some form of alarm placed outside the boiler.

Anti-Friction Metal or *White Metal.*—A general term for alloys specially intended for use on bearing surfaces. Such a metal should provide a surface which does not readily cut or abrade when the lubrication is scanty, and when properly lubricated the coefficient of friction should be very small. As a result the heat developed and elevation of temperature at high pressures per square inch of bearing surface will be small. The wear should be very slow and the durability consequently great, while at the same time the metal should not be so hard as to endanger transferring the wear to the piece which the bearing is to support, nor should it be too hard to work readily with a hand scraper. The well known *Babbitt metal* is one of the most familiar examples of this class of materials, though in recent years many other varieties have been placed on the market. Such metals are usually alloys of some two or more of the metals copper, tin, zinc, lead and antimony. The typical modern form of bearing consists of a backing or support of cast iron steel or brass to furnish the necessary strength and stiffness, lined on the bearing face with anti-friction metal cast into cavities with overhanging edges for holding it firmly in place.

Ash Chute or *Shoot.*—A shoot or cast metal tube, leading usually from a convenient point inboard to the outside of the ship, through which ashes are disposed of as hoisted from the fireroom. In modern practice the chute preferably leads down alongside the ship to a point below the water line, so that the ashes are ultimately discharged under water. A hose is often kept playing into the chute to assist in freeing the passage.

Ash Cock.—A cock admitting water from outside the ship, or in some cases from the delivery side of a pump, to a hose used for wetting down the ashes after their withdrawal from the ash pits.

Ash Ejector.—An apparatus for disposing of ashes directly from the fireroom. In Fig. 3 A represents a cast metal chute, or pipe, leading from the fireroom up and out through the side of the ship near or slightly above the water line. At the lower end this chute connects with a hopper B, into which is led a pipe from the discharge of a pump. This pipe enters to near the lower end of the chute, into which its discharge is directed, and is contracted to a nozzle, so that the water issues with a high velocity. The hopper may be closed by a cover, and if in this condition the discharge valve is opened and the pump started, a stream issues with high velocity from the upper end of the chute, even against the head of water which

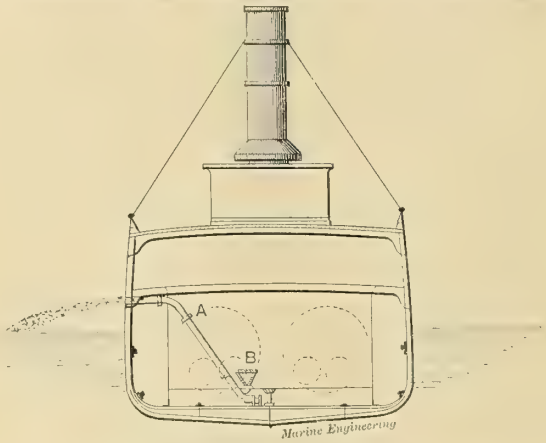


FIG. 3.

may result from the location of the latter below the water line. If then the cover is removed and ashes shoveled into the hopper, they are caught by the stream, carried rapidly up, and ejected free of the ships side in a jet of mingled ashes and water.

Ash-hoist.—A mechanism for hoisting ashes from the fireroom. The typical form consists of a small steam engine and winding drum, the engine being controlled by a simple form of reversing gear, so that it may be readily run in either direction or stopped.

Ash Pit.—The space within the furnace beneath the grate-bars. This space is used for the introduction of air beneath the grate, for working the fire from the under side, and for the withdrawal of the ashes.

Ash Pit Door or *Damper.*—A door covering the front of the ash pit and serving to check or control the inflow of air.

Atmospheric Line.—A line drawn on the indicator diagram, with the space below the indicator piston shut off from the steam cylinder and freely open to the air. This line often serves as a reference from which to measure pressures on the card above or below that of the atmosphere.

Auxiliaries.—A general term, including various machines and pieces of apparatus used in a more or less auxiliary or secondary manner. It is frequently used to include all machinery other than the main engines and attachments connected directly thereto. For example, auxiliary boiler, auxiliary pump, auxiliary valve, etc.

Babbitt Metal.—See *Anti-friction metal.*

Baffle Plate.—A plate or sheet of metal placed in a current of gas, liquid or vapor, for the purpose of controlling or directing its motion. Thus baffle plates are placed in the furnaces, or among the tubes of certain boilers for the purpose of directing the flow of hot gas through or among the tubes; they are also placed in the water space of other boilers to assist the circulation, while in a condenser they are used to intercept the rush of steam directly toward the air pump suction, and to compel it to pass into other parts of the condenser, thus giving a more uniform distribution over the cooling surface.

DURING THE MONTH.

Belfast, Ireland, imported American pig iron direct.

The British torpedo boat Empress, launched at Laird's yard in Birkenhead, is designed for a speed of 33 knots. She is 235 ft. long and has engines of 10,000 I. H. P.

A record in the discharging of a coal cargo was made by the steamer Chili at South Chicago. With four rigs 3,179 tons of coal were unloaded in 16 hours and 45 minutes.

H. M. battleship Magnificent made a new British record for coaling at sea. She took on 775 tons at the average rate of 160 tons an hour. The highest hourly record was 174 tons.

Cable advices reported placing of an order by the Hamburg-American line for a sister ship of the monster "Pennsylvania," which was described and illustrated in our issue of April last.

The largest floating dry dock in this port was put in the water at Erie Basin, Brooklyn. It is 270 ft. long and has a lifting capacity of 2,500 tons. It was built by the owners, William Gokey & Sons.

The Craig Shipbuilding Co., of Toledo, secured the contract for the steel inspection vessel for the use of the U. S. Engineer Corps at Buffalo. Contract price was $11,970 and delivery was guaranteed before April 15, 1898.

Plans for the new Allan line steamship Castilian, to ply between Liverpool and Montreal, have been approved. She will be 520 ft. long, about 58 ft. beam and of about 9,000 tons. She will be of the intermediate type, with large freight and good passenger accommodation and of moderate speed.

The large machine shop of the American Steel Barge Co.'s new plant at Superior was completed and preparations begun for installing the heavy machinery. A variety of other improvements are well under way, including an air compressing plant for working pneumatic tools and riveters, and electric hoists and traveling cranes.

A big auxiliary yacht, the Princess Alice, for the Prince of Monaco, was launched at Laird's yard in Birkenhead, England. She is 225 ft. long, 34 ft. beam and 20 ft. deep, and is designed to steam at 12 knots. The Prince is known in the scientific world as an enthusiastic biologist, and will use the yacht while cruising to take deep sea soundings.

The committee of Lloyd's which had under consideration the North Atlantic load-line question recommended the application of the winter load-line to all points north of Cape Hatteras. This would do away with the advantage which is now enjoyed by several southern ports in the loading of vessels deeper than is allowed from northern ports.

Arrangements were about completed between the New York, Philadelphia and Norfolk Railroad Co. and the Delaware River Iron Ship and Engine Building Co. for the construction of a new passenger vessel for the Cape Charles route. She is to be a single screw boat, 230 ft. long, 41 ft. beam and 15 ft. deep, to carry 250 passengers and a large amount of baggage.

The fireboat W. L. Strong, launched recently at the yard of John A. Dialogue & Son, Camden, N. J., is being rapidly completed for service in New York harbor. Her general dimensions are: Length, 110 ft.; beam, 20 ft.; draught, 9 ft. She is fitted with a single screw driven by a compound engine, and with pumps with a capacity of 6,000 gallons per minute, delivered at a pressure of 175 lbs. per sq. in.

An order is soon to be made in the British Navy granting warrant rank to the "Engine Room Artificers" who are employed in large numbers in the fleets as assistants to the commissioned engineers. Fifty appointments will be made and this number gradually increased. A rather stiff examination will have to be passed to get this promotion, and only those who have had ten years' continuous service will be eligible.

The steamer Spartan Prince, built by Short Brothers, Sunderland, England, for the Prince line, to ply between New York and Genoa, was sent on her trial trip. She is about 5,000 tons, dead weight, and is fitted with triple-expansion engines of 2,600 I. H. P. A mean speed of 15 knots was reached. This vessel, besides having large freight capacity, has accommodation for fifty first-class passengers and about 1,000 in the steerage.

A contract was concluded by the Detroit Dry Dock Co. for the construction of a steel propeller for a Puget Sound syndicate for service on the Pacific coast. The dimensions are, length, 165 ft.; beam, 27 ft.; depth of hold, 13 ft. Triple-expansion engines of 1,000 horse power will be fitted with boilers equipped with Howden hot draught. She is intended to carry a large number of passengers and about 250 tons of freight. The cost is given as $75,000.

A new record was made by the steamship China of the Pacific Mail line between Yokohama and Honolulu and between Honolulu and San Francisco. The entire trip, including 19 hours and 36 minutes detention at Honolulu was 14 days, 12 hours and 18 minutes. The passage from the Islands to 'Frisco was made in 5 days, 7 hours and 41 minutes. The highest speed attained on the trip was 18.85 knots. The previous records of the vessel were beaten by 1 day, 1 hour and 40 minutes.

The annual report of the Pacific Mail Steamship Co. for 1897 shows that the number of passengers carried to and from China and Japan was about 12,000, an increase of 25 per cent over the previous year, and about 40 per cent more than the number for the corresponding trips in 1895. Of these figures a considerable percentage is composed of tourist travel. The company has been figuring for some time upon the construction of a new vessel, which will probably be in the neighborhood of 7,000 tons.

A deal was perfected by which the stockholders of the Globe Iron Works Co. secured control of the Ship Owners' Dry Dock Co., which now gives them a controlling interest of all the dry dock property in Cleveland, as they already control the Cleveland Dry Dock Co. The docks acquired by the Globe Co. are in dimensions, respectively: 430 ft. long, 50 ft. wide and 16 ft. over the sill, and 300 ft. long, 55 ft. wide and 13 ft. over the sill. With such extensive dock accommodation the company is in position now to repair the hulls of several vessels simultaneously.

The steamship Persia, of the Hamburg-American line, was purchased by the Atlantic Transport line to run between New York and London. She was built by Harland & Wolff in 1894, and is 445 ft. long with a net tonnage of 3,687 tons. Other changes of vessel ownership include the transfer of the Red D line steamer Curacoa to a syndicate for use in the Alaskan trade, and the Morgan line steamship Morgan City to the Joseph Ladue Mining and Developing Co., for the same trade. The sale of the Cunarders Scythia and Parthia for service between Seattle and St. Michael was also reported.

The New York and Cuba Mail Steamship Co. closed a contract with the Cramps, of Philadelphia, for two 5,000 ton, 16 knot twin screw steamers. They are to be built in accordance with the requirements of the Government for auxiliary cruisers, so that in time of war they can be equipped with quick-fire guns. The general dimensions are given as, length, 360 ft.; beam, 50 ft.; depth, 32 ft., and draught about 20 ft. Triple expansion engines and Scotch boilers equipped with Howden draught will be installed. The vessels will have two smoke stacks and pole masts. Passenger accommodation will be unusually fine.

QUERIES AND ANSWERS.

Q.—Is it true that the beam of a side wheel engine stops moving during each revolution? R. C.

A.—Yes. When the crank is passing over the center the beam is at rest, or in other words, it is motionless twice during each revolution.

Q.—The engineer on our boat says you cannot see steam. Is he right? F.

A.—Look in the gauge glass between the water and the top of the glass, when steam is up, and judge for yourself. If you don't believe the steam is there try smashing the glass with a shovel or any thing handy, and you will get a practical demonstration that you will likely remember.

Q.—What is meant by the terms "lead" and "throw of the eccentric" used with regard to an engine?

FIREMAN.

A.—Lead is the amount of opening given to the valve on the steam side when the engine is on the center. The throw of the eccentric is the distance between the center of the crank shaft and the center of the eccentric. An eccentric is simply a substitute for a crank, to convert a rotary into a reciprocating, or to and fro motion, and so you can readily see the applicability of the term you mention.

Q.—What is the smallest amount of coal needed to produce one horse power per hour? T. S.

A.—The best record made by a land engine was 11 67 pounds of steam per horse power. Tests have shown more than twelve pounds of steam produced with one pound of coal. With a combination of multiple expansion engines and boilers equipped with hot draft and very modern feed water heating appliances in the S. S. Inchmona, a record of .999 pounds of coal is claimed. This is probably the figure for main engines only. It is the auxiliaries in a vessel which are really wasteful of steam, and the coal consumption as usually stated, includes all steam apparatus from the main engines to the steering gear.

Q.—Please state a rule for finding the velocity of flow of water in a pipe? N. P.

A.—The following formula is what is required:

$$V = 48\sqrt{\frac{h}{l}}\,d$$

In this V = the velocity of flow in feet per second, h = the head of water in feet, l = the length in feet, and d = diameter in feet. The rule is: Divide the head in feet by the length in feet, multiply the product by the diameter in feet, extract the square root of the product, and multiply by 48. The product will be the velocity in feet per second.

Q.—I had an argument with a man who insisted that if the valves of the water gauge are partially closed the pressure in the glass will be less than that in the boiler, or than would be in the glass if the valves were wide open. Is this so? T.

A.—No, it is not. No matter how small the opening through the valves might be the pressure in the glass, and consequently the water level, would be exactly the same as in the boiler, though, of course, a glass with wide open connections would more quickly show changes of water level than one with the openings partially closed. Carelessness in packing a gauge glass will sometimes choke the opening and reduce the area of connection with the boiler considerably, and this might be so for a long time and not noticed. It should be the aim of an engineer to keep gauge connections clear and full open at all times when under steam.

Q.—We have a jet condenser made of cast iron, the same kind as that used with beam engines on boats. It is honey-combed or eaten away at the manhole. Which is preferable for a patching, brass or copper? If the brass is preferable kindly state what objection there is to copper or vice versa?

ONE OF YOUR READERS.

A.—If the corrosion you mention is due to electro-chemical action, or to galvanic action, as it is frequently called, and if salt water is used in the condenser, brass or bronze would be preferable to copper for the material of the patch. This is due to the fact that the electro-chemical action between iron and brass is much less strong than between iron and copper. In your case, however, we assume that fresh water only is used in the condenser, and if so, there would be little choice between the brass and the copper, so far as corrosion due to electro-chemical action is concerned. This is because all such actions in fresh water are very weak. So far as resistance to corrosion from chemical causes alone is concerned, copper is usually somewhat more resistant than brass, and might in this case be preferable. We would suggest, however, that in case the nature of the repairs is such as to allow the fitting of a patch or cover of iron or steel, this would probably be more satisfactory than either brass or copper so far as corrosion is concerned, whether due to chemical cause alone or to electro-chemical action.

OBITUARY.

The death of the eminent hydraulic engineer, James Platt, on December 29, is announced by our English exchanges. Deceased was head of the firm of Fielding & Platt, hydraulic machine tool builders, of Gloucester. Besides having the management of an extensive engineering business, deceased was very prominent in scientific circles in England. He was a member of Council of the Institution of Mechanical Engineers, a member of the Institution of Civil Engineers and also of the Iron and Steel Institute. He was a native of Manchester, where he was born in the year 1834. He received his technical education as an articled pupil in the great machine tool shops of Francis Berry & Sons, Sowerby Bridge, Yorkshire, where his father was works manager. Afterward Mr. Platt was engaged in general engineering work, taking special interest in smelting apparatus. It was in 1866 that the firm of Fielding & Platt was founded. In conjunction with R. H. Tweddell, Mr. Platt secured the first patents for a hydraulic riveting machine in 1873. Since then the firm has built a large proportion of the hydraulic shop machinery in use in Europe. One of the last big jobs undertaken by the firm was the special riveting plant for the construction of the White Star leviathan Oceanic, now building at the yard of Harland & Wolff, at Belfast. Deceased is survived by a widow, five sons and a daughter. His eldest son, John Platt, M.E., is now engaged in engineering work in New York.

Jacob G. Neafie, president of the Neafie & Levy Ship and Engine Building Co., died at his residence, 1201 North Broad street, Philadelphia, January 16. He was 82 years old, but, nevertheless, up to a day or two before his death he gave personal attention to professional work at the office of the company. Deceased was the founder of the business, which from 1860 to 1891 was a private enterprise, but in the latter year became an incorporated company. He was born on Christmas day, 1815, in Monmouth county, N. J., and while he was quite young the family moved to New York city, where he was educated. In his earlier years he showed a marked ability for mechanical invention, and after a good practical training he opened a machine shop in Philadelphia. In the year 1844 he moved to the premises now occupied by the company at Beach street, and took in two partners. The versatility of his genius was shown in the construction of a successful steam fire engine for the city of Philadelphia, which is still in active service. His attention to this form of engine had been called in a casual way. Many fine vessels have been launched at the company's yard during his long administration.

Hiram G. Southworth, an old-time shipbuilder, died at his home, 27 Park street, Medford, December 20, aged 94. He was born at Duxbury, March 4, 1803. After learning the trade of ship joiner he came to Medford early in 1831, and with the exception of one year, when he was employed at the yard of Jenks & Coffin, Salem, his whole after life was given to the building of the stanch merchant vessels that gave shipbuilding on the banks of the Mystic a widespread reputation. He was probably the oldest Free Mason in the country, having been a member of the fraternity for 71 years.

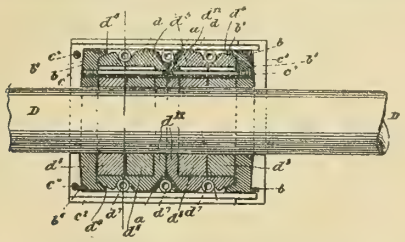
John J. Crofts, a pioneer marine engineer on the Pacific coast, died late in December, about 66 years of age. He was born in Lynn Crofts, Nottinghamshire, England, and went to the Coast in 1849. He was in the service of the Pacific Mail Steamship Co. for twenty-seven years and was then transferred to the Pacific Coast Steamship Co., and there remained until the time of his death.

Owen Williams, a well known lake marine engineer, of Detroit, died of pneumonia at Chicago, aged 70 years. He was an active member of the Marine Engineers' Beneficial Association.

SELECTED PATENTS.

595,811. METALLIC RING PACKING. *Leopold Katzenstein, New York, N. Y. Filed March 3, 1897.*

In a packing, the combination of sectional end rings *b*, intermediate sectional rings *d* recessed for the reception of sectional metal pieces d^3, the rings *d* being beveled at each end and recessed peripherally, springs for holding the rings *d* firmly around the piston-rod, a triangular spring expansion-ring *a* intervening be-

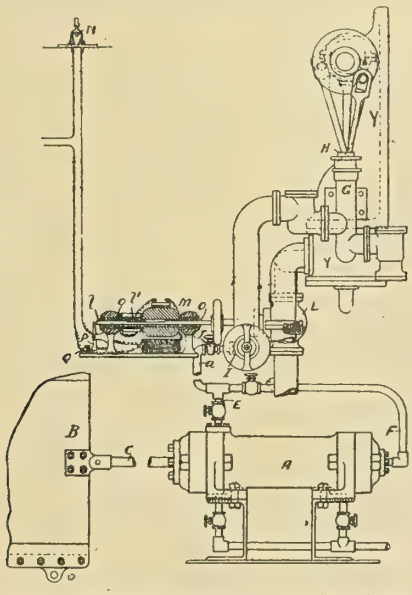


KATZENSTEIN METALLIC PACKING.

tween the rings *d d* and a pin or pins for holding the rings in alignment, adjacent sectional rings breaking joints with each other from end to end of the packing. The combination of inside conical flanged end rings *b*, intermediate sectional rings *d* recessed for the reception of segmental pieces d^3, the said rings *d* being beveled at one end to enter the flanged end rings *b* and at the other end to form a triangular groove, a triangular spring expansion-ring *a* between the rings *d*, means for preventing the rings from turning one on the other, the said rings breaking joints with each other from end to end of the packing. The combination of flanged end rings, intermediate sectional spring-rings beveled at one end to enter the flanged end rings and at the other end to form a V-shaped groove, the intermediate rings being recessed for the reception of segmental pieces d^3 and provided with flanges d^{12} and a sectional spring-ring *a* intervening between the intermediate rings.

592,430. APPARATUS FOR CLOSING WATER-TIGHT BULKHEAD-DOORS. *Thomas Moodie, Hamilton, Scotland. Filed November 7, 1897. Patented in England, July 7, 1896.*

Apparatus for closing bulkhead-doors in steamships

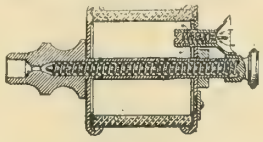


APPARATUS FOR CLOSING BULKHEAD DOORS.

consisting of a steam-pump whose steam-supply valve is connected to and actuated by an electromotor brought into operation by a switch on the bridge or other part of the ship and a hydraulic or other pressure cylinder connected to each bulkhead-door and whose plunger is actuated by fluid under pressure supplied by the pump. In apparatus for closing bulkhead-doors in steamships the combination of a hydraulic or like pressure cylinder having its piston-rod or plunger connected to the bulkhead-door, a ram or pump operated by a steam-engine to supply fluid under pressure to the hydraulic cylinder, an electromotor having its armature-spindle arranged to operate the steam-supply valve of the engine and conductors provided with switches on the bridge and at other suitable points for bringing the electromotor into operation. In apparatus for closing bulkhead-doors in steamships, the combination with a steam-pump adapted to transmit power for actuating the door, of an electromotor having its armature-spindle connected to the steam-supply valve of the engine and adapted by the action of the motor upon the throttle-valve to open it and admit steam to a high-speed engine provided with rams which supply fluid under pressure to the cylinders, the motor by its rotation opening a throttle-valve to admit steam to the engine.

592,179. OIL-CUP. *Wallace E. Tillinghast, East Greenwich, R. I. Filed Oct. 10, 1896.*

The combination with an oil cup for rapidly moving parts of machinery and provided with the cylinder, inlet and outlet openings for the oil, the stem, and upper and lower heads; of an air valve, provided with a casing inserted in an opening in the upper head extending partly within and partly without the cylinder and provided with lateral ports opening into the cylinder, a valve seat in the casing, a valve on the valve seat and arranged to open inwardly, and a spring in casing below the valve and normally holding the valve upon its seat, the valve casing being formed



OIL-CUP.

above the valve seat with an open flared or bell-shaped mouth into which the stem of the valve is extended, whereby the valve casing acts as a funnel and collects and concentrates the air directly upon the valve to unseat it when the cup is moving upwardly

CALENDARS FOR 1898.

The calendar sent to us by the Youngstown Iron & Steel Roofing Co., Youngstown, Ohio, has a handsome heading in a 12 in. half tone reproduction of the famous oil painting, "A Prisoner." It is an attractive calendar on green paper with gold ornamentation and printing in colors.

The calendar issued by the Central Electric Co., Chicago, is a very neat little desk calendar 4 in. by 5 in. in size, made to stand up. It has a sheet for each month on the front part and a complete calendar for the year on the back.

H. Bloomsburg & Co., Newport News, Va., and Wilmington, Del., issue a neat embossed calendar to which are attached several sheets with pictures of well known steamers using the jets and circulators manufactured by this company.

The most elaborate and one of the handsomest calendars issued this season comes from the E. G. Bernard Co., Troy, N. Y. In the center is a female figure holding aloft an electric torch, and about this figure are the months' calendars. On one side is a small thermometer. The workmanship is of fine handwork and is done in several colors.

Readers of Marine Engineering can have copies of these calendars by writing for them and mentioning this publication.

TRADE PUBLICATIONS.

A 3 1-2 in. by 6 in. 100-page book of endorsements from students in its mechanical courses is received from the International Correspondence Schools, Box 1111, Scranton, Pa. These endorsements are well worth the reading by men who contemplate a course in study, as they give an excellent idea of what these courses are and tell of results attained.

Boat, canoe and yacht hardware manufactured by M. E. Blasier & Co., Utica, N. Y., is fully illustrated and described in a 44-page catalogue just received. Each device is fully illustrated and there is almost everything in the line of brass and other metallic goods used in boat work. Every builder and user of small boats should have a copy of this catalogue handy for purposes of reference because of its completeness.

The demand for knock-down boats for Alaskan use has necessitated the issuing of a special circular by the American Knock-Down Boat Co., St. Louis, Mo. This circular contains descriptions of various types of boats, and has three large engravings showing the manner of constructing them, and also the compactness with which they are packed for transshipment. These boats are built for all services and include yachts and launches of any kind and size. To supply the Alaskan trade this company has opened an office at Seattle, Wash.

Machine tools for ship builders and metal workers of various kinds, manufactured by the Hilles & Jones Co., Wilmington, Del., are exceedingly well illustrated in catalogue O for 1898, just from the press. The catalogue is 9 in. by 12 in. in size, handsomely printed on coated paper, and each illustration occupies a full page, allowing barely enough space for brief descriptive matter. The illustrations are exceptionally good and show some massive tools which can be driven by belts or electric motors. Every ship and engine builder should have a copy of this catalogue.

BUSINESS NOTES.

A Good Dividend.—The directors of the Foster Engineering Co., Newark, N. J., at their meeting on January 18, declared a dividend of ten per cent. out of the earnings of 1897.

Change of Business.—The retirement is announced of Mr. Norman St. George Campbell from the firm of W. D. Forbes & Co., of Hoboken, N. J. Mr. Forbes, the mechanical expert of the firm, will continue at the head of the firm.

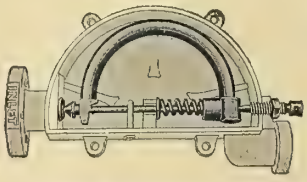
Burden Iron Chains.—In order that its chains and cables may be of the highest quality and abie to withstand the most severe strains, the J. B. Carr Co., Troy, N. Y., uses the celebrated Burden iron in all its chains and cables. A pamphlet giving a good deal of information regarding these chains is sent to all who wish it. It contains much information regarding weights, strength and sizes of cables, together with a number of testimonials from prominent users of chains in various parts of the country.

Yukon River Boat.—A very neat boat for use on the Yukon river, Alaska, has just been shipped by the Racine Yacht and Boat Works, Racine Junction, Wis. This boat was 35 ft. by 10 ft., very similar in type to the Gypsy Queen, illustrated in the January issue of Marine Engineering. Detailed description of this boat can be had by writing to this company. This company also has on hand a stern-wheel steamer for use on the Yukon river which is fitted with two 5 in. by 20 in. horizontal engines and Clyde marine boiler; a 25 ft. launch for A. Tubbs, Victoria, B. C.; one for C. B. Barber, New York city, one for William Tracy, South Ero, Vt., and still another launch for Cincinnati parties.

An Extra Engineer

not needed to look after the "Heintz" Steam Trap. It's automatic, sensitive, lasts for years. Operates by expansion of sealed tube, which closes the valve as live steam enters the trap—212°: valve open at 211°. Smallest size discharges a gallon of water a minute.

Guaranteed to give best results and save coal and steam. Our Booklet "G" interesting to users. Ask for it.



William S. Haines Company,

136 South Fourth Street, Philadelphia.

"The Heintz—the best—tho' it has imitators."

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For Every Purpose.

We make lamps for Yachts, Boats, Boathouses, Cabins, Wharves, Walks, or anywhere, indoors or out, where a good strong light is wanted.

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VALVES

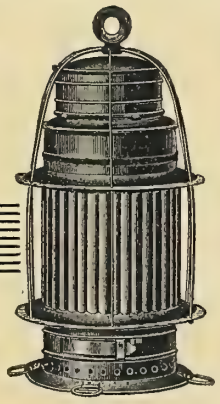
Of all kinds for automatically controlling Steam, Water and Air Pressures.

SEND US YOUR PROBLEMS.

Mason Regulator Co., Boston, Mass.

Light Rays in Signal Lamps should **be Concentrated** not diffused.....

These Lines Illustrate



the action of our patent
FLUTED LENS
on the rays of light in our
SIGNAL LAMPS.
Everything in Marine Lamps.
Shall we send you our catalogue?

Russell & Watson, 145 Main St., Buffalo, N. Y.

TRUSCOTT ENGINES.—The Truscott gasoline engine, illustrated in our January issue, was on exhibition at the Sportsmen's Show in New York last month, and was the first opportunity offered in the East to examine this new engine. Three different sizes were shown, of one, four and eight horse power. Because of the hurry in arranging for the display the company was not able to exhibit one of its boats, which have had a reputation for years for high quality. The Truscott Works are at St. Joseph Mich.

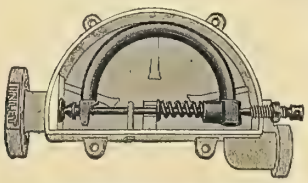
PLENTY OF WORK.—T. S. Marvel & Co., Newburg, N. Y., have all the work in their yard that they can possibly attend to for this winter. They are building a 60 ft. streel tug with a 14 by 18 engine for the Newburg Dredging Co., the steel hull for the new Catskill boat for which the W. & A. Fletcher Co., of Hoboken, will build the engines and boilers. Nine steamers are hauled out on the docks for extensive repairs and twenty-five are tied up alongside for repairs. One of these is the Ulster, which tried to "climb the mountain" as shown in our December issue. Strange to say, this accident, serious as it seemed, only cost $300 worth of damage.

ALCO LAUNCHES AND ENGINES.—The most conspicuous exhibit at the Sportsmen's Show in the boating line was made by the Marine Vapor Engine Co., Jersey City, N. J. There was a 25 ft. double cockpit yacht-tender fitted with a 5 horse power Alco engine. The launch was made of Spanish cedar, beautifully finished, and because of its unusual type attracted much attention. Adjoining this was a 25 ft. hunting launch equipped with a 3 horse power Alco engine, and as this launch had sail set, it was noticeable from all parts of the hall. In addition to this display the company showed two Alco engines which were operated by compressed air, the one horse power engine displaying a speed to the attached propeller which would make an electric fan motor envious.

23 Years

in constant use — and no failures. Thousands of dollars saved by the "Heintz" Steam Trap. Simple — Durable — Efficient. Works in any position — discharges water to any height. No floats, no levers or delicate parts. Economizes fuel and labor — saves space — perfectly automatic—requires no watching. Money refunded if trap proves unsatisfactory within a year. Send for one on thirty days' trial free.

Booklet "G" for the asking, will show you how to save money.



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136 South Fourth Street,
Philadelphia.

"The Heintz—the best—tho' it has imitators."

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THE EMPIRE MOTOR.—Three different sizes of the Empire gasoline motor were shown at the Sportsmen's Show last month, and circulars descriptive of them were distributed. This motor is manufactured by C. C. Riotte & Co., 1,955 Park avenue, New York.

MARINE RANGES.—A large number of steamers and barges on the lakes have been supplied with ranges and boilers by Russell & Watson, 145 Main street, Buffalo, N. Y., who carry a full line of these goods of their own production in addition to signal and other lamps, etc.

ANTI-FRICTION METAL.—The Eureka anti-friction metal advertised elsewhere by Fenton & Co., 39 Cortlandt street, New York, has made a reputation for itself as shown by very complimentary testimonials. It has proved especially efficient in marine work as the marine field is one to which the company has devoted itself. It makes in addition a line of non-corrosive metal goods.

DAIMLER MOTORS.—An excellent exhibit of the various uses to which Daimler motors have been applied was made by the Daimler Motor Co., Steinway, Long Island City, N. Y., at the Sportsmen's Show in New York city last month. It included both marine and stationary types of the engine, a very handsome launch, fully equipped, motor vehicles, etc. A neat catalogue descriptive of these applications of the motor was distributed.

GLOBE ENGINES.—The exhibit of Globe engines made by the Pennsylvania Iron Works Co., Philadelphia, Pa., at the Sportsmen's Show last month, comprised several engines, one of them being of 25 horse power. There was also a very handsome 33 ft. launch equipped with a Globe engine, with a large cabin forward and a cockpit aft of the engine room.

YACHT AND LAUNCH EXHIBIT.—The Gas Engine and Power Co., and Charles L. Seabury & Co., Con., Morris Heights, New York city, occupied a large space at the Sportsmen's Show in New York last month. The most noticeable exhibit was a superb mahogany launch 22 ft. long with large open cockpit. There was also exhibited a small Seabury boiler suitable for a small yacht, and two Seabury yacht or launch engines, one compound and the other triple expansion.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

POSITION WANTED.

An engineer of many years' practical experience in engineering and dredging, desires position, or would take charge of work for a contractor. Unexceptional references.

ENGINEER, care MARINE ENGINEERING.

Paul S. Reeves,

PHILADELPHIA,

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Propeller Wheels

in all the BRONZES.

Marine Castings a Specialty.

Phosphor-Bronze, Brass, Babbitt Metals.

Castings from ¼ to 10,000 lbs. Weight.

Anti-Friction Metal.

Especially Adapted for

HEAVY AND HIGH SPEED ENGINE BEARINGS AND ALL KINDS OF MARINE WORK.

Outwears, runs cooler and with less lubrication than any babbitt or anti-friction metal made.

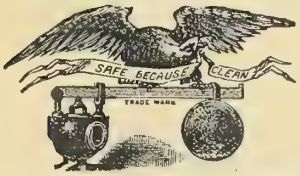
Descriptive Circular, Testimonials and Samples Free. . . . .

All Kinds of Superior Brass, Bronze, Copper and Non-corrosive White Metal Castings.

FENTON & CO., SELLING AGENTS,

39 Cortlandt St., New York.

THOS. C. WARLEY & CO., *Manufacturers of*



BOILER CLEANSING COMPOUNDS

Main Office: No. Eleven So. Ninth St., Philadelphia, Pa.

P. O. BOX 1262.

These Compounds are unequalled. They give satisfaction where others fail. They are especially adapted for use in Marine Steam Plants. WRITE FOR DESCRIPTIVE CIRCULAR.

COLE'S PRESERVER OF MARINE BOILERS

....For the Removal and Prevention of Scale and Corrosion....

It effectually prevents foaming, likewise galvanic action where the feed water is condensed and comes in contact with copper, brass or galvanized iron.

A. N. COLE, CHEMIST,

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(*Supplement to M*

THE LATE UNITED STATES SECOND-CLASS BATTLESHIP MAINE.

Blown up and sunk in Havana harbor on the night of February 15, 1898.

(Supplement to Marine Engineering, March, 1898.)

PROFILE

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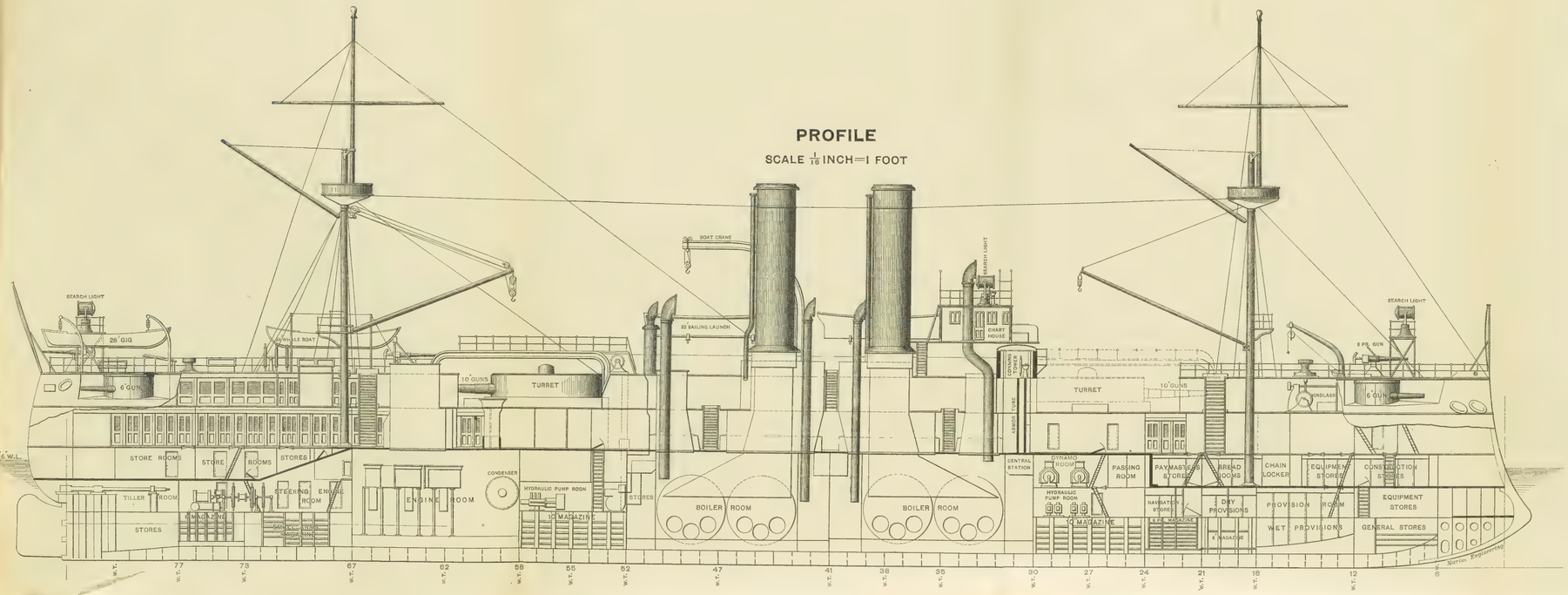
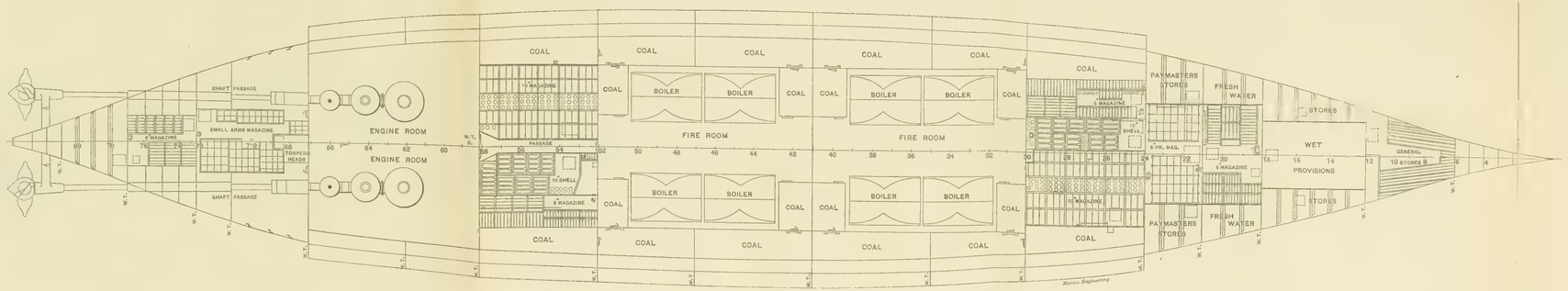


HOLD PLAN

SCALE $\frac{1}{32}$ INCH = 1 FOOT.


SHAFT PASSAGE
SMALL ARMS MAGAZINE
6 MAGAZINE
TORPEDO HEADS
ENGINE ROOM
ENGINE ROOM
SHAFT PASSAGE
COAL
6 MAGAZINE
PASSAGE
10 SHELL
8 MAGAZINE
COAL
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